Mosaics make a Site

The Conservation *in situ* of Mosaics on Archaeological Sites

Proceedings of the VIth International Conference of the International Committee for the Conservation of Mosaics



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SIXTH CONFERENCE OF THE INTERNATIONAL COMMITTEE FOR THE CONSERVATION OF MOSAICS

MOSAICS
MAKE A SITE

ROME
2003



MARGARET ALEXANDER opening the VI^th^ ICCM Conference.



Opening of the VI^th^ ICCM Conference: [From left to right] DEMETRIOS MICHAELIDES, MARGARET ALEXANDER, MIGUEL ANGEL CORZO, DEMOS CHRISTOU, ANDEAS PATSALIDES, and GAËL DE GUICHEN.

MOSAICS MAKE A SITE: THE CONSERVATION *IN SITU* OF MOSAICS ON ARCHAEOLOGICAL SITES

Editor
DEMETRIOS MICHAELIDES

Proceedings of the VI[th] Conference
of the International Committee for the Conservation of Mosaics
Nicosia, Cyprus, 1996

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Bank of Cyprus Cultural Foundation
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Mosaics Make a Site: the Conservation *in situ* of Mosaics on Archaeological Sites
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PREFACE

Many have been the times, during the last few years, that I was on the brink of abandoning the idea of publishing this volume. The Nicosia conference, held as long ago as the autumn of 1996, went absolutely smoothly and all was set for a speedy publication of the proceedings. A series of unfortunate events, however, led to a change of plan and the postponement of the publication. The loss of that particular slot in my schedule proved almost fatal. As is often the case in these situations, other obligations became more pressing and the preparation of the proceedings took second place. There was no lack of money, thanks to the generosity of the Getty Conservation Institute. What was not readily available any more was the time to co-ordinate and edit so many papers, and go through hours and hours of taped discussion in an assortment of languages. All the same, work did go on albeit at a very reduced pace. However irritating and frustrating I may have found it at the time, I am grateful to my friends and colleagues for exerting often less than polite pressure on me to get on with the work. Protagonists in this were Roberto Nardi, Federico Guidobaldi, Nicholas Stanley-Price and Martha Demas and I thank them all for pushing me as far as they could.

With all the good will in the world, however, the publication of these Proceedings could not materialize without financial backing. The ICCM exists thanks to the good will of the members of the Board all of whom work on a voluntary basis, and the Committee has no capital or steady income other than the subscription fees. I am, therefore, immensely grateful to the Getty Conservation Institute and in particular Marta de la Torre (then at the GCI) for giving me the financial support necessary to prepare and publish this material. Like the conference itself, these Proceedings owe their existence to the support of the Getty Conservation Institute. This publication also owes a lot to ICCROM. Realizing the practical difficulties I was facing, especially with me being in Cyprus and the printers in Tivoli, its Director General, Nicholas Stanley-Price offered the assistance of ICCROM in seeing the volume through the final stages with the printers. I am most grateful to him for this badly needed kiss of life, which led to the final publication of the volume.

Over the years, several people have assisted me in the preparation of the Proceedings. I would like to thank Linda Hulin and especially Ian Todd for smoothing out many

of the linguistic problems resulting from people of so many different nationalities writing in English. My thanks also go to Henri Lavagne for doing the same with the French texts and discussions. Above all, however, I would like to thank Robert Killick (ICCROM) for doing the final editing and layout of the volume and seeing it through the press.

The present volume follows the pattern used for the conference itself. It is divided into six sections, namely 1) Philosophies Favouring *in Situ* Conservation, 2) Planning for the Conservation of an *in Situ* Mosaic, 3) Documentation of the Condition of Mosaics *in Situ*, 4) The Treatment of *in Situ* Mosaics, 5) Shelter Protection for *in Situ* Mosaics, and 6) Presentation of *in Situ* Mosaics. A keynote presentation introduces each section (the last two are dealt with in the same presentation) and then follow shorter papers dealing with related matters. I would like to specify at this point that all the keynote papers were commissioned and edited by the Getty Conservation Institute. Some departures from the programme with respect to the shorter presentations must also be pointed out. The paper by Antonella Altieri, Domenico Poggi and Sandra Ricci, as well as that by Anastasia Panayotopoulou and Stella Raftopoulou, were accepted for presentation at the conference. Unfortunately, their authors were unable to come to Cyprus so the papers were not delivered during the conference. All the same, it was thought advisable to include them in the publication. Claude Bassier was also unable to come to the conference. Henri Lavagne gave a paper in his place which, however, he withdrew from publication. This was replaced by another paper sent by Claude Bassier. Moreover, although it is not common practice, it was decided to publish the poster presentations, as some of them are directly related to matters discussed in the papers. However, not all the authors sent their contributions for publication. It should also be mentioned that the discussions following the different papers were originally much longer. These have been edited and many sections which seemed repetitive or that did not add anything to the argument have been omitted. Finally, I would like to point out that the papers and bibliographies have not been updated since they were sent for publication in 1998.

A novelty of the Nicosia meeting was the introduction of a title, namely "Mosaics make a site". This proved very successful in that it focussed the main interest of the presentations and the discussions on *in situ* conservation. Themes were also introduced in the two ICCM conferences that have taken place since, with equally felicitous results: "Mosaics: conserve to display?" at Arles/Saint- Romain-en-Gal and "Wall and floor mosaics: conservation, maintenance, presentation" at Thessaloniki. As always in these conferences and as is to be expected, most of the papers dealt with mosaics from the Mediterranean world. The Nicosia conference, however, also introduced the discussion of problems that mosaics from the New World are facing, something that, together with conservation issues of works from the Arab world and the Indian subcontinent, will, I hope, play an ever more important role in our future meetings. Although very late in appearing these Proceedings follow the publication of the previous ICCM conference held in Faro and Conimbriga, which appeared in 1994. With the imminent publication of the proceedings of the Arles/Saint- Romain-en-Gal meeting of 1999, and those of the Thessaloniki meeting of only last year well under way, I am happy to see that we are, at last, up to date.

In ending, I would like to thank once again all those mentioned in the Opening Remarks, who assisted me in their various ways in putting the conference together. A conference not followed by a publication of its proceedings, however, would amount to little and would have gone contrary to the aims of the ICCM, which include the dissemination of knowledge and scientific know-how related to mosaic conservation. This is why I am equally grateful to those that made this publication possible. Namely, the Getty Conservation Institute in the persons of Marta de la Torre and its then Director Miguel Angel Corzo, and more recently, Martha Demas, Jeanne-Marie Teutonico and its present Director Timothy P. Whalen. Equally, I owe an immense gratitude to ICCROM and its Director General, Nicholas Stanley-Price for all the assistance given.

A final apology: The conference took place a long time ago. In the meantime, several of the authors had changed addresses and in some cases it proved impossible to trace them for a final check of their papers before going to the printers. I do apologize for that but it was very much a case of either now or never.

Demetrios Michaelides
University of Cyprus
August 2003

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Read by Aïcha Ben Abed

Conclusion and closing remarks ... [illegible]
Roberto Nardi

Demetrios Michaelides

Archaeological Research Unit, University of Cyprus

Good morning, Ladies and Gentlemen, and welcome to Cyprus, and Nicosia in particular.

It is just over three years ago that my friends Roberto Nardi and Gaël de Guichen from ICCROM approached me with the proposal of holding the 6th Conference of the International Committee for the Conservation of Mosaics here in Cyprus, under the auspices of the University. Very wisely, I did not accept, despite the fact that I was very tempted by the idea and I could see the great advantages of the geographical location of Cyprus for colleagues coming from the Eastern Mediterranean. The University had barely opened and I did not consider that it would be ready to accept such a financial and organizational responsibility, especially since archaeological conservation did not feature anywhere in its syllabus.

Soon after, we met at the 5th Conference of the International Committee for the Conservation of Mosaics at Faro in Portugal, and I was approached yet again with the same proposal. I explained the reasons why I did not want to commit myself or the University, and underlined the fact that since the ICCM has no capital I could not even begin to consider accepting such a task. It was then that another friend, Marta de la Torre, who was following the conversation, moved in — like a real *dea ex machina* — to say that, if I were to agree to host the conference, the Getty Conservation Institute would support me, and that she only needed to make a phone-call to Los Angeles before confirming this. She did, the answer was positive, and, since over the years I had excellent collaboration with the Getty Conservation Institute on several projects, I decided to accept. I must confess that I had not quite realized just what this entailed, and I must admit that, during the last three years, there have been times that I regretted taking this decision. Everybody, however, has been wonderful and if we are able to meet here today, this is due to many friends and generous donations from many bodies. I will thank these people individually on another occasion, but I would like to thank now the Getty Conservation Institute, its Director Miguel Angel Corzo, Marta de la Torre of course, Lori Anglin, who has taken care of most of the Los Angeles side of things, and Sheri Saperstein who has assisted us in many ways.

Marta de la Torre was a *dea ex machina*, but she was not the only one. When I was looking for a venue for the conference, another friend, Dr Maria Iacovou, the Director of the Cultural Foundation of the Bank of Cyprus, offered to host the conference in these premises, which at that time did not even exist — certainly not in their present form. It has been a real feat to get this place ready on time just for us — this, in fact, is the first time this room is being used — and for this, as well as all the services of the Cultural Foundation, the publications and the hard work of Mrs Alexia Kolota and all the staff, I am most grateful to Dr Iacovou and, of course, to the President of the Foundation, Mr Andreas Patsalides.

Greek is not one of the official languages of the ICCM, and grecophones must thank Mr Demetrios Pierides — whose house some of you visited yesterday — who has kindly provided for the Greek simultaneous translation.

I would also like to thank my colleagues, Drs Lina Kassianidou and Frosso Egoumenidou, who, despite the fact that their professional interests have nothing to do with either mosaics or conservation, have given me their unstinted help; Maro Mouskou and Vasiliki Demetriou, the two secretaries that have looked after the affairs of this meeting; and, last but not least, my wife Sarah, who has helped in more ways than one with the organization of this conference.

Finally, I would like to thank all of you for coming to the conference. Although us Cypriots tend to think that Cyprus is the centre of the world, I know that it is quite far from many places, so thank you for coming all this way. I must confess that it gives me enormous pleasure to see so many friends gathered together under one roof in my own country. We have tried to organize things in the best possible way, so that you enjoy your stay here. If some things don't quite work out the way we intend them to, I ask for your indulgence. The weather is one thing that escaped our organizational skills, but just think that everybody else in Cyprus is thrilled to have some rain after such a long dry period!

You will see and hear a lot from me in the next few days, so I will not keep you any more for now. In wishing you a most profitable and pleasant stay, I now call the Rector of the University of Cyprus, Dr Miltiades Chacholiades to deliver his address.

Miltiades Chacholiades

Rector of the University of Cyprus

Dear Colleagues, Distinguished Guests, Ladies and Gentlemen,
It is a great pleasure for me to welcome you to Cyprus and to be present at this opening session of the 6th Conference of the International Committee for the Conservation of Mosaics. Although I was not yet the Rector when Dr Michaelides committed the University of Cyprus to be one of the sponsors and organizers of this meeting, and despite the fact that our university does not yet have a department dealing with conservation, we are indeed proud that this conference is taking place here in Nicosia.

Our university is newly founded and, until the new campus materializes, we are rather short of space. Moreover, because at this time classes are in session, it was impossible to host this meeting at the University. This is why we are grateful to the Cultural Foundation of the Bank of Cyprus for offering these wonderful, newly renovated premises for the occasion. The contribution of this foundation, as you will realize, has been multifarious and more than generous, and all its staff have worked hard to have everything ready for today. This meeting, however, could not have taken place without the contribution of the other sponsor, the Getty Conservation Institute. This institute covered a large part of the expenses involved in the organization of this conference and, over the past four years, its personnel worked in close association with Dr Michaelides to put together this meeting and to prepare all the material that you will be using during the conference.

ICCROM in Rome, the Pierides Foundation of Larnaca, as well as the Ministry of Education and Culture and the Municipality of Nicosia, have all contributed to the realization of this meeting. To all I extend our sincere thanks.

The University of Cyprus was established in 1989, and accepted its first students in 1992. At present, the University has four fully constituted faculties: the Faculty of Humanities and Social Sciences; the Faculty of Pure and Applied Mathematics; the Faculty of Economics and Management; and, newly established this year, the Faculty of Letters.

These Faculties comprise twelve departments, all of which offer undergraduate degrees, and many of which are now capable of offering graduate degrees, at both Masters and Ph.D. Level. All graduate programmes are expected to be in operation by the beginning of next semester.

Although there was no Department of Archaeology, this discipline featured prominently in the form of the Archaeological Research Unit, a centre for the study and promotion of the archaeology of Cyprus, offering postgraduate degrees. I am pleased to inform you that, as of this academic year, our university has a new department offering an undergraduate course in history and archaeology. As I have already mentioned, there is not, as yet, a department or centre for conservation, but conservation is one of the subjects that will be taught during the undergraduate course in archaeology and, given the aims of our University, and knowing Dr Michaelides' interests and concerns, I am sure that this is one field that is likely to develop rapidly in the future.

The preservation of our cultural heritage, through its study and understanding, is, as a matter of fact, one of the principal aims of the University. Our country is going through very difficult times and our cultural identity is under threat. The Turkish invasion of 1974 has destroyed a large number of monuments, while the subsequent occupation of a very large part of the island has wreaked havoc to monuments and museums there, with the result that we are now chasing artefacts and works of art in the four corners of the earth in order to repatriate them. A case in point — and relative to the general theme of this meeting — is that of the apse mosaic of Panayia Kanakaria in the occupied village of Lythrankomi. In an effort to detach the most attractive and saleable parts, the rest of this rare and precious work of art was destroyed, while the detached fragments, after many peregrinations, ended up on the art market at Indianapolis. There followed a clamorous court case that fortunately ended with the ruling that these mosaics belong to the Church of Cyprus. The story is well known, and I know that some of you present here today have been involved and played a role in the eventual repatriation of these mosaics.

These damaged fragments have now been conserved, and you can see them in the Byzantine Museum of the Archbishopric of Nicosia. This is not exactly *in situ* conservation, but the whole of this incident, its political, religious and ethnic undertones aside, is very pertinent to the theme of this conference. The fragments, detached from the apse they originally decorated and exhibited in a museum, have lost most of their original meaning. They remain beautiful, but all the logic and thought that was behind their composition in the architectural space of the church has been lost. In the same way, although I have not been able to see it for myself, since we, Greek Cypriots, have no access to the occupied part of our country, I am sure that the church these mosaics once embellished must appear naked and deprived, not only of its decoration and atmosphere but also of its original sense of religious order as reflected in Byzantine decoration.

This is, of course, a very special case, but there is no doubt that mosaics, be they wall mosaics or floor mosaics, were made to decorate specific spaces. The choice of the subjects depicted or the layout of a floor is more often than not directly related to the function of the rooms they decorated. In the past it was often difficult (and sometimes impossible) to conserve mosaics *in situ*, so thousands and thousands of them were removed from their find spot and ended up either as exhibits or, in most cases, on slabs of concrete deposited in museums' yards and storerooms. The majority of these mosaics survive, but the buildings they once decorated more often than not have fallen into complete ruin, since, deprived of their decoration and having little else that is immediately attractive and "exploitable" by the tourist industry, they have been abandoned to weeds and the elements of nature. I am sure, for example, that had the mosaics in the Roman houses of Paphos been removed into a museum, the site would attract few but the specialized visitor.

With new approaches to the conservation of archaeological sites and continually improving techniques for the conservation as well as the protection of mosaics, it is now possible, in the majority of cases, to preserve them *in situ*, and I am delighted that the theme of this, the 6th meeting of the International Committee for the Conservation of Mosaics, is addressing exactly the pros and cons and the issues involved in the *in situ* conservation of mosaics.

You have a heavy schedule and some interesting tours in front of you. For these I wish you every success, but for lunch today, I invite you to a buffet and drinks offered by the University of Cyprus in one of the most beautiful buildings in Nicosia, recently restored by the Department of Antiquities and given over for the use of the University.

Miguel Angel Corzo

Director, The Getty Conservation Institute

Distinguished Speakers, Colleagues, Friends, Ladies and Gentlemen,
We are really delighted to be here today in this land that we love so dearly and to which we come very often and always with great enthusiasm. This is not the first time that the Getty Conservation Institute is involved in activities related to *in situ* conservation or to mosaics, the first conference that the Institute organized in 1985 was a conference on *in situ* archaeological conservation. Since then, the Institute has been strongly involved in these activities. We at the GCI are part of a larger organization, the Getty Trust, which is made up of various entities dealing with the different aspects of the visual arts and culture. As such we have, like tesserae, come together in the new site that will be opening next year where we hope to continue our support and collaboration for all of the activities related to the cultural heritage. Indeed, the new logo that we have, and the icon that is the symbol of the organization, resembles very much a mosaic, and it is meant to represent how so many elements can come together in an aesthetic and pleasing fashion.

It is quite extraordinary to see such an assemblage of friends and of people devoted to the conservation of mosaics. Organizing, together with the University of Cyprus and others, this 6th Conference of the International Committee for the Conservation of Mosaics is something that we committed ourselves to many years ago. The staff of the GCI has been involved in the activities of the committee already for some time, including one of our members, Giora Solar, who serves on the Board of the Organization. But we have never had an official role in any of its very important meetings.

As has been mentioned before, our interest in this particular conference arose out of the work that we had seen undertaken by our friend Demetrios Michaelides, and by noticing at the conference in Portugal, several years back, that certain topics kept emerging repeatedly during the short periods of discussion that followed all the papers. We also felt that other topics, perhaps very important ones, were absent. So Demetrios Michaelides, Marta de la Torre and Margaret MacLane — all colleagues — came upon the idea of organizing a different kind of conference, one where topics would take the centre stage and where periods of discussion among all participants would allow for a more insightful view of the topic. So, here we are, as Demetrios Michaelides said, after three eventful years, particularly for him, attending this conference in Cyprus.

The conference I think, to a great extent, reflects the approach to conservation that we have at the GCI. The conservation of the cultural heritage must take into account the needs and aspirations of societies in which it exists and it must equally be concerned with its preservation and its use. We cannot equate conservation with treatment and intervention. Conservation is preservation of the original fabric, of the information it contains, and of the values embodied in its heritage. Conservation for us is the responsible use of the heritage for the benefit of society. The theme of this conference, Conservation of Mosaics *in situ*, lends itself to a broad examination of all of the elements of the process of preserving the heritage.

The topics I am going to enumerate now follow the sequence of the work of the conservator when approaching a mosaic on the site. Firstly, we have to look at the philosophy of conservation, at the ideas and beliefs that guide all of the decisions to be taken. Then an often overlooked step must be taken into strong consideration, and that is planning on how all of this approach is going to be followed. The third step, documentation, which we believe to be fundamental, is used to gather information but is also a very important and determining tool for diagnosis of the problem. The fourth step, and that is only if it is required, is treatment. Then we have to think about shelters, which on all archaeological sites are, of course, always very problematic. Last of all, but certainly not least, is the presentation of the mosaic. This is an element of the approach to conservation that is finally beginning to be considered as an integral part of conservation.

Of course, I am not going to elaborate on each of these topics. Very capable keynote speakers will be giving us, during the next few days, their perspectives on each of these points and we are all sure (and certainly hope) that this will generate the intense discussions that are characteristic of this group of professionals dealing with this topic.

I think it is also very appropriate that the conference takes place in the Mediterranean and, particularly, in the island of Cyprus, in the centre of the Universe as Demetrios has already clearly signified in his opening address. That is why it takes such a long time for all of us to get here. The Getty Conservation Institute has, from the beginning, worked in the Mediterranean area. We have had projects in Egypt, Israel, Tunisia, Spain and, of

course, here in Cyprus. We have also been in contact, in many different ways, with other countries in this area. One of the projects that we have carried out in Egypt, for example, involved the conservation of the tomb of Queen Nefertari. Projects in Israel include courses on *in situ* archaeological conservation, and so on.

The first collaboration with the Department of Antiquities in Cyprus was precisely that of the conservation of a mosaic, the Orpheus mosaic, which is in Paphos. I believe that next Sunday, if I remember the programme correctly, we will be visiting the site, and will hear from Mr Hadjisavvas the new plans for its presentation and protection. Several members of his staff, as well as other consultants who have worked in the project, are present here at this conference.

Also there in Paphos, we have held two courses on conservation and management of archaeological sites. The management of archaeological sites is a topic that is very close to the Institute's thinking. Last year, together with our colleagues from the Getty Museum, we organized a conference here in the Mediterranean region that started in Tunisia and ended in Athens, that had the privilege of having many Directors of Antiquities and Directors of Tourism of the Mediterranean come together with experts and staff members to talk precisely about the importance of site management, and how this can, in fact, provide protection for the cultural heritage while, at the same time, also provide the possibility for the site to be really useful to many different audiences.

We are going to continue our involvement in the conservation of mosaics over the next few years. We will certainly continue with our support for this Conference as, in the course of the next few months, we will be looking at the publication of the proceedings. This is about the extent that the GCI is going to be involved with the ICCM, apart from being good friends and supporters of its efforts. But this is not where our involvement with mosaics will end. I am very pleased to convey to you the news that we are focussing on an important and significant initiative that we will be launching in the next few months. We hope for the GCI to establish, together with some of you and with some other members of the field of mosaics, a strong partnership and a strong alliance to devote to, and really focus the main thrust of our efforts on the conservation of mosaics. We hope to do this by selecting a few sites around the Mediterranean where we can undertake a research project, together with partners in other institutions, that will look at the problems of mosaics, at the typology of problems, and, particularly, at the methodology of how to go about solving the problems of mosaics. We hope that, through this initiative, we will be able to significantly advance the view on what is the best thing for a mosaic, how it can be best preserved and how it can be better used.

Many persons have, of course, participated in this organization. I think that I became very excited for the first time about the ICCM when I had the occasion to meet Margaret Alexander. She has been for me a guiding light in all of the efforts of the Institute. She has been a true friend, she has always given us the best sort of advice, guidance and orientation and has shown relentless energy in engaging the GCI in the entire process. So I am really delighted that out of this particular friendship, and out of this particular professional relationship, we are advancing and, as we said several years back, we will have a conference in Cyprus, and, Margaret, here we are.

I would also like to recognize our friend, our good friend, Demetrios Michaelides, because he has been very enthusiastic, extraordinarily professional and very supportive of all of our ideas, and we hope that we have been as supportive as he wanted us to be of his

ideas. I would like to mention that Marta de la Torre and her staff, Lori Anglin and Sheri Saperstein, have devoted a tremendous amount of time to making sure that the conference was efficiently organized. I am sure that the next few days will demonstrate this and, knowing Marta and her team as I do, I am sure that we will be extraordinarily well served.

Lastly, let me say that for us at the GCI it is a true delight to be with you here. We strongly believe that the best role we can play is to listen as you tell us how we can support you and your efforts in conservation, and that it is through these alliances, and these friendships, and these solid professional relations that we can best serve the world of cultural heritage.

Margaret Alexander

President, International Committee for the Conservation of Mosaics

I am sorry to be here in such a degraded state, but perhaps I can be conserved like the mosaics! Distinguished sponsors, reporters, colleagues and friends of mosaics, I am honored to speak on behalf of the International Committee for the Conservation of Mosaics and to express our thanks to our hosts and sponsors and to thank all of you for participating.

It is a very large group, I think perhaps the largest we've ever had. We are delighted to be in Cyprus, an island with so many reminders of so many cultures, and so rich in treasures, not least your beautiful mosaics. It is the first time that the committee has met in the Eastern Mediterranean. This has led to participation by colleagues from countries previously little represented, or not at all, such as Cyprus itself, Greece, Israel, Jordan, Lebanon, I think even Egypt. We had hoped that someone from India was coming but this did not materialize. We are delighted to have you with us and we hope that you will continue to be with us in future meetings.

This is the sixth International Conference of Mosaic Conservation, under the auspices of the ICCM. It had been organized, as you know, by the University of Cyprus, and the Getty Conservation Institute, with additional funding and support of the Cultural Foundation of the Bank of Cyprus and the Pierides Foundation. We are extremely grateful to all these institutions and to many individuals, especially the personnel of the Archaeological Research Unit of the University of Cyprus. But certain people do deserve from us, from our committee, special recognition. First, and above all, Demetrios Michaelides of the University and a member of our Council, and members of the Getty Conservation Institute, in particular Miguel Angel Corzo, Marta de la Torre and Lorry Anglin

The conservation of mosaics *in situ* has been the basic principle of the ICCM since its inception in 1977. Papers on conservation *in situ*, whether in an archaeological site or historic monument, have dominated our conferences, but in no particular pattern.

It is to Marta de la Torre that we owe the special form of this conference, in which that approach is the guiding force. Each session is dedicated to a particular aspect: philosophy, planning, documentation, management, and presentation. Each session is introduced by a keynote speaker and is followed by a few contributors dealing with the same topic. We realise that this scheduling has curtailed the number of individual presentations. We hope it is made up for by an increased number of poster sessions, particularly suited to topics requiring a thorough visual presentation, by face-to-face discussion, and, especially, by the increase in time available for questions, challenges and thoughts for discussion.

You have heard a great deal about our conference and what we have aimed to do, so I am not going to take much more time, I simply want to make a suggestion in closing. In this conference, as in past conferences, conservators are talking to conservators. In future meetings, I urge that we seek more contributions from archaeologists, architects and mosaics specialists who, working directly on mosaics as you do, are deeply involved with their condition and conservation. Planning, documentation, and presentation are not the domain of any one discipline. If a site is to be properly documented and presented, we must collaborate. Archaeologists are going to continue to uncover mosaics, either in salvage operations, or in planned excavations. Let us then work together, so that where mosaics survive they do truly make the site.

Andreas Patsalides

Chairman, Bank of Cyprus Cultural Foundation

Dear Fellow Organizers, Dear Participants, Ladies and Gentlemen,
We have been expecting this moment for a long time now. When, in September 1994, I signed our agreement to sponsor this International Conference, along with other distinguished and prestigious institutions, and to host it in the Cultural Foundation's premises, renovation and construction work had hardly begun in the building.

You are, today, the first to be making use of the Foundation's lecture halls and libraries, and we ask you to show patience, in case some matters have not reached the expected point of perfection. Your presence here is indeed an unprecedented occasion, and a turning point in the history and function of this building that was constructed early in the 1940s to house the administration of the oldest and largest banking institution of the island.

The Bank of Cyprus was founded in 1899, as the nineteenth century was coming to a close. The Phaneromeni headquarters — as the building was known for more than half a century — served its purpose well until three years ago when we moved to new premises at the outskirts of Nicosia, where I look forward to receiving you this evening at the reception given by the Cultural Foundation in honour of your visit to Cyprus.

The hall next door used to be my office — the office of many successive governors of the Bank of Cyprus — and there it was that we signed, in 1984, the founding act of the Cultural Foundation.

The Bank of Cyprus and its Cultural Foundation — with its priceless national treasures, the great map collection and the rare printed and manuscript sources on the history of Cyprus — will never abandon the old city of Nicosia. It is right here — one floor below — that we plan to open the Museum of Cyprus Cartography.

From the roof-top where, in a while, you will be having your coffee gazing at the Mediaeval Cathedral of Saint Sophia, you will realize that we stand at a distance of one hundred metres away from the "green line" that has divided Cyprus by military force for twenty-two years now.

By this shameful border, we have aimed at establishing a cultural fortress, where we can rescue, protect and promote the cultural history of our homeland. We are a very young institution in a land of great turmoil, but we will persevere. Our heritage, which includes much of what you will be talking about, namely mosaics, is both our defence and also the element that breaks our island's isolation and brings us closer to the international community.

Cyprus has been and, I trust, will remain an open-hearted, hospitable and humane island, where our *xenoi*, our guests, will always be treated as friends. I wish you every success in your discussions and I look forward to greeting you once again this evening.

Demos Christou

Director of the Department of Antiquities, Republic of Cyprus

On behalf of the Department of Antiquities, I welcome to Cyprus the participants of the 6th Conference of the International Committee for the Conservation of Mosaics, organized by the Getty Conservation Institute, ICCROM and the University of Cyprus, on the subject of conservation *in situ* of mosaics.

In recent years, great progress has been made in the field of mosaic conservation and considerably more sophisticated means are now available, providing a wider range of treatment options. The importance of conferences and seminars of this type, aiming at discussion of problematic issues on particular aspects of conservation, and the presentation of results on related projects for the enhancement of knowledge in the field, cannot be overemphasized.

It is my firm conviction that, through the papers and discussion of expert participants in the field on particular case studies, a further insight into the problems of conservation will be gained.

As is well known, a vital part of the role of the Department of Antiquities concerns the protection of our cultural heritage, the legacy from the past, for the future. The con-

servation and protection of archaeological sites is, therefore, one of the main concerns of our Department. The preparation and implementation of General Master Plans for the sites of Choirokoitia, Paphos and Kourion may be viewed in this general spirit, aiming, in other words, at solving the problem of preserving and presenting archaeological and architectural remains that have been exposed not only to the elements but to the effects of frequent visiting. Apart from heritage management policies, the Department urges foreign missions to limit the extent of their excavations according to the conservation needs that can be met on their site.

Co-operation between the Department of Antiquities and the Getty Conservation Institute has been continuous and fruitful, ever since its creation in 1982. The Institute's efforts to address conservation needs of cultural heritage on a worldwide basis are deeply appreciated and I wish to take this opportunity to extend out thanks for the Institute's support towards the achievement of common goals.

It is our fervent wish that one day, and before it is too late, one such programme will involve the conservation and protection of our sites in the occupied part of the island, which have been lying unprotected, in the mercy of weather conditions and looters, under imminent threat of destruction, for the last 22 years.

With these thoughts in mind, I welcome all the participants once again, feeling confident that this conference will be a most successful one.

Gaël de Guichen

Head, Museum and Collections Unit, ICCROM

I accepted with real pleasure to say these few words at this 6th Conference of the International Committee for the Conservation of Mosaics. Indeed, having been, together with Claude Bassier and Henri Lavagne, behind the creation of the committee in 1977, I have been in a good position to view its remarkable development over the years.

Let's face it, not everything has evolved. The Committee still does not have a permanent secretariat or an address, or a bank account. But does it matter? Thanks to the enthusiasm, the commitment and professionalism of its members, this Committee has been able to hold six meetings and conferences (Rome 1977, Tunis 1978 and Periguex 1980, Aquileia 1983, Soria 1986, Palencia 1990, Conimbriga 1994) and now here we are at the seventh. The proceedings have always been published and sometimes translated into English, French and Arabic, thus making available to specialists a total of 143 articles considered essential references in the field.

On reading through these articles, it is possible to see how the mosaic, from being considered an isolated object out of context, is now perceived as an integral part of an architectural whole. This changed way of thinking can be completed by the following observations:

- who used to think *mosaic*, now thinks of *site*
- who used to think of *individual*, now thinks of *team*
- who used to think of *cost*, now thinks of *investment*
- who used to think of *day-to-day*, now thinks of *long-term programme*
- who used to think of *secret*, now thinks of *communication*
- who used to think of *'how?'*, now thinks of *'why?'*

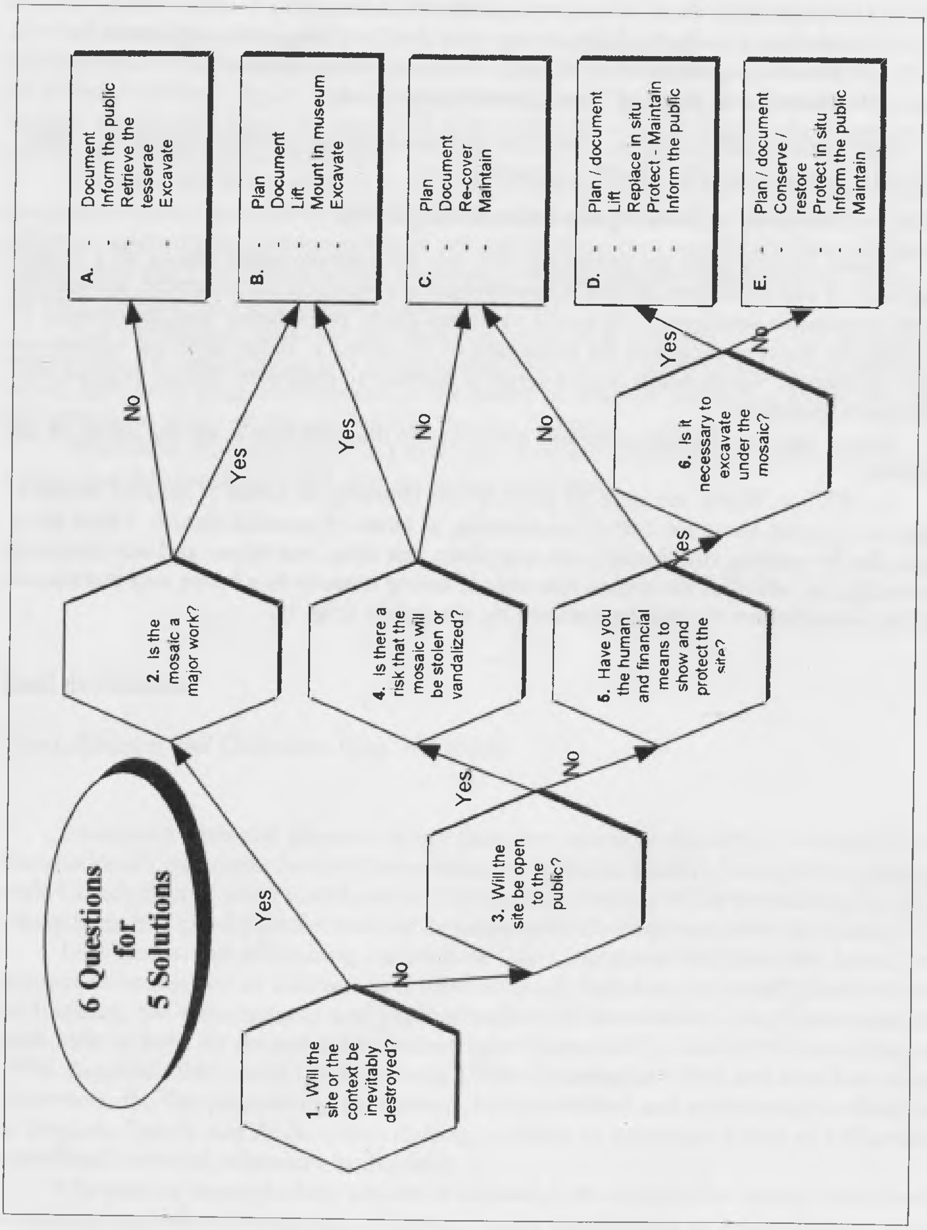
Each of these points will be illustrated and developed by speakers during this week. As for me, I would just like to add a seventh point:

- who used to think *rigidly*, today thinks *flexibly*.

Indeed, twenty years ago practically the only solution envisaged was to lift a mosaic floor when it was discovered. It was acknowledged as a technical achievement, as were the almost systematic detachment of mural paintings thirty years earlier and the transfer of paintings on wood to canvas at the beginning of the century. Today there are various solutions proposed, which result from a series of answers to questions that go beyond mere technical problems.

Indeed the five possible solutions given in the diagram below are the result of six questions.

In 1977, in Rome, we were 54 participants thinking in terms of isolated mosaics. Today, in Cyprus, there are 160 of us debating in terms of mosaics on site. I have great hopes that by pooling our doubts, our questions, our ideas, our hopes and our technical knowledge, we will find the means not only of saving mosaics in a better way but also of making them known to, and appreciated by, the public (Fig. 1).



6 Questions for 5 Solutions
1. Will the site or the context be inevitably destroyed?
2. Is the mosaic a major work?
3. Will the site be open to the public?
4. Is there a risk that the mosaic will be stolen or vandalized?
5. Have you the human and financial means to show and protect the site?
6. Is it necessary to excavate under the mosaic?
Yes
No
A. - Document - Inform the public - Retrieve the tesserae - Excavate
B. - Plan - Document - Lift - Mount in museum - Excavate
C. - Plan - Document - Re-cover - Maintain
D. - Plan / document - Lift - Replace in situ - Protect - Maintain - Inform the public
E. - Plan / document - Conserve / restore - Protect in situ - Inform the public - Maintain

Fig. 1

SESSION 1

PHILOSOPHIES FAVOURING *IN SITU* CONSERVATION

Alessandra Melucco Vaccaro

Philosophies favouring *in situ* conservation

The theme of this conference, as reflected in its title, highlights the great importance mosaics have in defining the features of an archaeological area. The conference title also convincingly summarizes the reasons for keeping these mosaics where they are found.

It might seem surprising, at first, to have another international conference focusing on the problem of conserving mosaics *in situ*. Many of us already consider this the best alternative, a position supported by international charters and recommendations. These charters reflect the evolution of theoretical thinking and practice as they have expanded beyond the artifact to emphasize context. Context is now included as an essential element of the preservation of the historical, physical and cultural values of cultural heritage. A similar evolution has occurred in the conservation of frescoes. Frescoes and mosaics have often been considered to share many similarities, and for years conservation approaches developed for the former were applied, appropriately or not, to the latter.

The Burra Charter [1] of 1979 marks a milestone in the importance of *in situ* conservation stating in Article 9 that "*A building or work should remain in its historical location. The moving of all or part of a building or work is unacceptable unless this is the sole means of ensuring its survival*" [2].

Such statements are supported by increasing evidence of the destructive consequences of lifting mosaics, both for the mosaic itself and for the archaeological site where it was found. Nevertheless, professionals have resisted adopting conservation *in situ*. This resistance is anchored in an entrenched mentality and other, well-established models of intervention, but also on widely held opinions that the results of *in situ* treatments have been unsatisfactory or negative. This mentality is reflected in J. Cronyn's handbook [3], which does not even discuss stabilization *in situ*, and M. Berducou's publication [4] that presents a distressing panorama of poor conditions or even complete destruction of mosaics left *in situ*, with examples spanning from Orbe, Switzerland to Volubilis, Morocco.

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[1] Australia ICOMOS, International Council on Monuments and Sites, *Charter for the Conservation of Places of Cultural Significance* (*The Burra Charter*), 1979.

[2] *Idem.*

[3] J.M. Cronyn, *The Elements of Archaeological Conservation*, London 1990, p. 126.

[4] M. Berducou, *La conservation en Archéologie*, Paris 1991, pp. 299 ff.

Many of the difficulties encountered are, in fact, the result of the situation found in the Mediterranean region where the resources required to accomplish effectively *in situ* conservation are not commensurate with the quantity and importance of the mosaic floors that exist, and that continue to be found (often in rescue excavations). In many of the cases discussed by Berducou the decision to keep a mosaic on site was not taken as a part of a general strategy of conservation, maintenance and use. When the decision is made to preserve a mosaic *in situ*, attention must be paid not only to the technical and operational reliability of the intervention in itself, but to establishing a coherent and on-going maintenance program. On the other hand, the argument often made that additional information is obtained from lifting and replacing a mosaic [5] is a false one, because the same amount of information can be obtained without removing the mosaic, by taking advantage of losses and discontinuity of the surface to carry out investigations.

This resistance of professionals to conserve mosaics *in situ* seems to be reflected in the recent documents of ICOMOS and the Council of Europe. Article 6 of the 1990 ICOMOS Charter on *Protection and Management of the Archaeological Heritage* states that "*the overall objective of archaeological heritage management should be the preservation of monuments and sites in situ, including proper long-term conservation and curation of all related records*" [6]. The 1992 European Convention on the Protection of the Archaeological Heritage [7] states in Article 3 that "*the elements of the archaeological heritage are not uncovered or left exposed during or after excavation without provision being made for their proper preservation, conservation and management*"; its Article 4 weakly endorses "*the conservation and maintenance of the archaeological heritage preferably in situ*", as does Article 5: "*to make provision, when elements of the archaeological heritage have been found during development work, for their conservation in situ when feasible*".

Arguments for conservation *in situ* were already made at the last three ICCM meetings [8]. During the 1994 meetings in Conimbriga, Portugal, Gaël de Guichen [9] highlighted that the general attitude towards mosaics is to focus first on the artifact and only se-

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[5] E. Chantriaux-Vicard *et al.*, "Aspects de la dépose", in *Conservation, Protection, Preservation. Proceedings of the V ICCM Conference, Conimbriga-Faro 1993*, Conimbriga 1994, pp. 87-92.

[6] ICOMOS (International Council on Monuments and Sites) *Charter on Protection and Management of Archaeological Heritage*. Adopted by the General Assembly, Lausanne, October 1990.

[7] Council of Europe, *European Convention on the Protection of the Archaeological Heritage Valetta 1992*, Strasbourg 1992 (European Treaty Series 143).

[8] See for example, A. Melucco Vaccaro, R. Nardi, G. de Guichen, "Conservation of Archaeological Mosaics. The State of the Problem in the Light of a Recent Course", in *Colloquio Internacional del Mosaico Antiguo, Proceedings of the IV ICCM Conference*, Palencia 1990, pp. 335-340; and in R. Nardi, "Preventive Conservation at Archaeological Sites", in "Aspects de la dépose", in *Conservation, Protection, Preservation Proceedings of the V ICCM Conference, Conimbriga-Faro 1993*, Conimbriga 1994, pp. 213-217.

[9] G. de Guichen, Discussion, "Aspects de la dépose", in *Conservation, Protection, Preservation. Proceedings of the V ICCM Conference, Conimbriga-Faro 1993*, Conimbriga 1994, pp. 166-167.

cond — albeit increasingly so in recent times — on the site and the context in which they are found. This is the same approach that was first adopted in the conservation of mural paintings. In that case, it took fifteen years to realize that detachment was not the solution to the problem. However, during that time, museum storerooms became crowded with detached frescoes, and archaeological monuments as well as churches were spoiled and abandoned to decay. In the twenty years since ICCM was founded, we have heard again and again a list of good reasons that support the conservation of mosaics *in situ.* I believe it is time to move to a more useful debate that points out obstacles and difficulties of *in situ* conservation. We should analyze these obstacles and put forward concrete proposals to overcome them, and then establish pilot projects that test new solutions. This new debate appears to be the main objective of this Conference.

There are some signs that the situation is changing. In the Mediterranean area, as elsewhere, there is an increasing appreciation for the preservation of the cultural landscape, of which archaeological remains and monumental ruins are essential elements [10]. It is being recognized that the archaeological heritage has many values — cultural, educational, and as symbols of identity and of common struggle against intolerance. Awareness of such implications is rising, and an increasing number of individuals and groups are directly or indirectly involved in decisions regarding the fate of ancient sites — a change from the past when the archaeologist was considered to be the individual responsible for most decisions.

Nevertheless, as a consequence of new demands and of the complexity of social context, the vulnerability of such sites is increasing. Environmental factors and lack of maintenance are the more obvious degradation agents. To these can be added the impact of interventions based on the use of inappropriate industrial materials that have proven, in the long run, to be much less reliable and compatible with ancient materials in field conditions than laboratory testing had led to believe.

The present situation is made more critical by the effects of natural catastrophes, and the damage created by man-made disasters such as wars, lack of planning in land use, unsustainable development models and the increase of mass tourism. All these factors not only threaten the archaeological heritage, they are also changing radically the experience of visitors to these sites. Tourism is an economic factor that is expected to produce benefits for local communities, and to fund conservation and enhancement programs. Too often, however, the phenomenon is not handled satisfactorily by local authorities, and the involvement of those charged with the care of the heritage is only marginal. This situation turns a potential benefit into an additional threat.

The characteristics of archaeological sites in terms of values, but also of vulnerability and of their role in sustainable development, is not yet fully understood by many political decision makers. Full awareness of the historical, cultural and environmental significance of an archaeological site must be the starting point for each improvement and

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[10] Council of Europe, Congress of Local and Regional Authorities, Draft European Landscape Convention. Fourth Session, Strasbourg, June 1997. This version was discussed on the occasion of the Intergovernmental Consultation Conference in Florence, 2 to 4 April 1998.

enhancement program; the preservation of its values must be the core of each master plan. Professionals more directly involved in preservation efforts — archaeologists, conservators and architects — are aware of the values and significance of sites, but they must adopt a more comprehensive approach to the problems of preserving, presenting and maintaining the site. This new approach must clearly assess the needs of the site, establish connections between all decisions, and define clear priorities, all of this done with the objective of preserving the site and maintaining a balance with its presentation [11].

The scientific community as a whole cannot delay much longer in embracing suitable preservation strategies. The threats to many important sites are increasing, and the gap between needs and resources is becoming larger. It is now urgent to adopt a policy of sustainable conservation based on preventive measures and maintenance programs that have a minimal impact upon ruins, and that are economically feasible. The emphasis must be on prevention and recovery strategies. Even if prestige interventions on masterpieces or on artifacts of particular significance must be carried out at times (since sponsors are more likely to be interested in funding this kind of project), the majority of resources must be dedicated to maintenance and routine care [12].

The preservation of mosaics must be considered in such a framework. Technical solutions to specific field and conservation problems are available, and their application has created a body of knowledge that is available. However, the choice of a solution must be based on an overall analysis of the specific conditions and needs of a given site. Almost all the statements and recommendations of the ICCROM publication on the conservation of archaeological excavations [13] are applicable to the care of mosaics since they are based on a thoughtful evaluation of the site and its needs. In all cases, the appropriate solution starts with the creation of a management plan that protects the site and provides for its appropriate use and presentation. To bring in professionals only when emergencies arise has proven to be unsuccessful and ineffective in solving complex conservation problems.

The choice of Cyprus as a venue for this meeting of ICCM is significant. It is here that the Getty Conservation Institute carried out some years ago the impressive detachment and *in situ* reinstallation of the Mosaic of Orpheus by the rolling technique, considered by those responsible for the project as "*not applicable to all mosaics*" [14]. It is here too that the erection of a *hexashelter* was foreseen as a temporary protection while waiting for an overall plan for the site [15]. These issues point to the complexity of the problem of

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[11] Some pilot projects (Raphael and MEDA) funded by the European Community deal with the same issues (e.g. AGESA and PISA projects) and are in particular aimed at defining the profile of '*site managers*' and helping archaeologists in site analysis and planning operations.

[12] See M. Laurenti, "Nuovi interventi a Castelleone di Suasa (Marche, Italy)", in *Atti II Colloquio AISCOM*, I. Bragantini e F. Guidobaldi eds., Bordighera 1995, pp. 241-248.

[13] ICCROM, Conservation on Archaeological Excavations, N. Stanley-Price ed., 2nd ed. Rome 1995.

[14] P. Mora in *The Conservation of the Orpheus Mosaic at Paphos, Cyprus*, The Getty Conservation Institute, California 1991, p. 6.

[15] N. Agnew and R. Coffman, *ibidem*, pp. 36-41.

conserving mosaics *in situ* and highlight the different elements that must be considered when making final and conclusive decisions.

To advance the discussions, I want to present a tentative list of difficulties and obstacles that I believe prevent conservation *in situ* from becoming the rule in mosaic preservation policies:

- it is necessary to exclude from all our discussions of conservation *in situ* mosaics found in rescue excavations and development works, except when the importance of the discovery is such as to demand the creation of a protected area, regularly watched and open to the public;
- otherwise, preservation *in situ*, emphasizing the conservation of the context, should be the rule for mosaics in areas permanently open to the public and in large scientific excavations;
- the problem of conservation *in situ* is not limited to new excavations; archaeological sites of the Old World, and of the Mediterranean area in particular, hold impressive ruins, creating the image of Antiquity held by present generations. However, they suffer from exposure to environmental factors and a long history of restorations and interventions; they have decayed; their values, significance and use have changed over time; in many cases, mosaics are the more durable witnesses, sometimes the only one still preserved on site, of the lost decorations and of the architectural quality of the ancient building;
- the protection of mosaics is one of the more controversial issues in archaeological sites, often due to a narrow definition of the problem: '*protection*' is usually understood as '*architectural shelter*';
- roofing is just one way to protect mosaics; more possibilities must be considered [16]: rescue operations and backfilling; temporary shelters during intervention or limited to unfavourable seasons; maintenance programs and drainage control;
- if sheltering proves to be the appropriate and effective solution for single elements, it is necessary to assess the impact of each of the proposed roofs, considered by itself and in relationship to the rest of the site; maintenance implications must be taken into account too;
- the ultimate aim is to find an acceptable balance between conserving, preserving the character of the site, and conveying an idea of the original function and historical significance of the ruin.

The approach I advocate consists of a comprehensive evaluation of the site and of its state of conservation, for which standard approaches for heritage analysis and planning could be used. This process would need to establish the values of the site, starting

[16] J. Podany, "Preservation of Excavated Mosaics by Reburial", in "Aspects de la dépose", in *Conservation, Protection, Preservation. Proceedings of the V ICCM Conference, Conimbriga-Faro 1993*, Conimbriga 1994, pp. 1-15.

with its significance in the history of archaeological discoveries of the Ancient World, and on through to its present values as an asset in economic and cultural terms. However, some current applications of this model of global analysis have been too narrow. Sample surveys about the vulnerability of specific sites with a great wealth of mosaic floors were carried out in Italy as part of the program *Monuments at Risk Map*[17] and in the similar British MARS Program (*Monuments at Risk Survey*)[18]. Neither inquiry encompasses information about all the surviving archaeological sites.

To conclude, I would like to highlight the various problems I have identified and summarize the key issues I have raised.

- the main obstacles preventing a successful adoption of conservation *in situ* are the lack of management plans for archaeological sites and of adequate resources for on-going maintenance programs;
- critical comparison of the success or failure of examples of the different strategies of preservation of mosaics (*in situ* vs. lifting) is not possible at present, since these interventions have not been monitored either in the short or in the long term. In fact, basic information regarding the condition of the resource, the character of the site and influencing factors are omitted or left unrecorded in standard condition reports — even those dealing with technical aspects;
- it is, thus, necessary to establish indicators suitable for monitoring and assessing the intervention results;
- to move forward it is necessary:
- to act at both national and international level;
- to promote the adoption of models for planning and intervention, based on the experience of pilot projects.

Let me stress once more my personal commitment to the conservation *in situ* of mosaics, and to its broad application. Let me also express the hope, that I am sure will be shared by the majority of the colleagues present here, that this Conference, so carefully prepared and so generously supported by important cultural institutions, will become not only a turning point in mosaic conservation but an important step in ensuring as well the survival of archaeological sites.

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[17] Ministero per i Beni Culturali e Ambientali, Istituto Centrale del Restauro, *Carta del Rischio del patrimonio culturale italiano (Risk Map of Cultural Heritage of Italy)*, Rome 1994. The idea behind the Risk Map is to develop maintenance and conservation methods that are based on an understanding of the physical and environmental conditions of each site.

[18] English Heritage commissioned the MARS Project (*Monuments at Risk Survey*) from Bournemouth University. The work is carried out in collaboration with the Royal Commission on the Historical Monuments of England. Its purpose is to provide up to date information regarding the general characteristics of the archaeological resources as well as specific details about the past, present, and likely future conditions of various kinds of monuments. See T. Darvill and G. Wainwright's "The Monuments at Risk Survey: an Introduction" in *Conservation and Management of Archaeological Sites*, 1,1 1995, pp. 59-62.

DISCUSSION

Lavagne: Je remercie Madame Melucco de cette introduction claire et précieuse. Je suis heureux de penser que c'est une archéologue qui a ouvert le feu, en quelque sorte, à cette discussion parce que, comme vous le savez, nous sommes deux professions à concourir pour les mêmes résultats : les spécialistes de la conservation et les archéologues (ou avec les archéologues). Il est très important que Madame Melucco, qui est à la fois une archéologue de terrain et en même temps qui travaille à la Direction des Antiquités depuis si longtemps puisse nous donner un point de vue général et une approche globale de nos problèmes. J'ai apprécié, en particulier, qu'elle prononce le mot de priorité. Il y a à la fois des décisions d'ensemble et des principes généraux à promouvoir avec force mais il faut aussi envisager les priorités. Et je pense que les interventions et les communications, que nous aurons aujourd'hui et demain, montreront que dans certains cas il y a malheureusement des choix à faire en fonction de ces priorités. Alors, nous pouvons commencer la discussion partant de la communication qui vient d'être faite.

Name unknown: We will be discussing the issues that were presented here in the following days of the conference, but I would like to ask you one question for clarification. Do you see the lifting of a mosaic and relaying it in place as an *in situ* conservation? If so, I should be glad to hear why you think it is *in situ*; if not, what is wrong about it?

Melucco Vaccaro: I think that it depends on the techniques employed. If lifting the mosaic is not necessary, other more reliable techniques should be substituted which respect not only the material structure and present state of the mosaic, but also its history and condition. I think that the sessions of this congress will demonstrate that there are other techniques available, and I think it is better not to employ lifting. But that is only my opinion, and others will, I think, offer more convincing arguments for choosing not to lift mosaics. But we are here not just to stress what must be done, but what is the best thing to do; rather than emphasizing traditional methods we should offer positive, practical available solutions.

Lavagne: Je vous remercie, Madame, même si vous nous avez placé dans ce que les Anglais appellent un 'corner'. Vous vous en êtes bien tirée. L'un d'entre vous est venu me demander s'il pourrait faire une intervention en italien. Je sais que l'italien n'avait pas été retenu comme langue du Colloque mais, étant donné que Madame Melucco est italienne, je crois que nous pouvons faire cette petite entorse au règlement. Je vais lui demander de parler en italien.

Fontanelli: (in Italian).

Melucco Vaccaro: Je ne sais pas s'il est necessaire de traduire, mais je crois que tout le monde a compris que le collègue italien de la Soprintendenza Archeologica de Flo-

rence a souligné l'importance de la conservation préventive qui requiert une présence continue dès le commencement des opérations sur les sites, surtout celle d'un spécialiste compétent en matière de conservation, de sauvegarde durant la phase des fouilles. Je tiens à faire une brève citation. J'ai rappelé que le petit texte *Conservation on Archaeological Excavations,* which was edited by Nicholas Stanley-Price, could be completely and plainly applied to preventive conservation of ruins on archaeological sites which have mosaic carpets *in situ.* Of course that is why I stress the problem. In my opinion, according to my experience and bearing in mind the horizon of the Mediterranean area, the problem of new excavation is not the only one. We have large sites of the utmost importance which have been exposed for centuries, and which may never have been excavated because of their upstanding remains; they are also important and suffering greatly from environmental and human factors. If it is important to apply the correct immediate preservation measures on new excavations, I think that no less importance should be attributed to the safeguard of the giants of archaeology, that is to say the sites of the Mediterranean area.

Neguer: Ma question s'adresse à l'architecte plutôt qu'au conservateur archéologique. En effet un site archéologique se développe dans le temps. Les constructions s'ajoutent les unes aux autres, pouvant créer un problème esthétique. Ma question est de savoir si nous devons projeter les toitures d'un site spécifiquement pour ce site ou bien créer chaque toiture en fonction du site ou du monument qu'elle protège?

Melucco Vaccaro: Je crois que la difficulté à laquelle nous devons faire face est la multitude d'interventions, surtout dans des sites aussi importants que ceux dont nous avons la responsabilité, et que parfois nous devons faire des restaurations de monuments qui on déjà été restaurés auparavant. J'ai rappelé le cas d'étude de Piazza Armerina où l'on est presque certain, à présent, que cette splendide couverture qui porte la signature d'un architecte important dans la culture de la conservation en Italie soit à l'origine même d'un problème. Il est évident que l'attitude commune n'est pas de déraciner, d'effacer tout ce qui a été fait, puisque parfois dans les restaurations effectuées dans le passé il y a des éléments qui ne peuvent pas être éliminés. Examiner des sites qui ont eu une vie longue et complexe est difficile. Et je crois que si nous avons un monument isolé, évidemment le problème de l'impact doit être envisagé dans l'optique de l'équilibre à établir ou à retrouver entre la ruine isolée et son environnement. Mais on peut avoir à faire à un site étendu, une ville entière dans laquelle tant de toitures ont été renouvelées entièrement ou partiellement ; je pense évidemment à Pompei. Il convient alors de faire une évaluation de la vulnérabilité du site, c'est-à-dire, examiner les parties non couvertes et celles qui ont une toiture désormais ancienne. Prenons l'exemple de Delle Corte. Il s'agit de toitures historiques en place depuis un siècle ou plus qui ont été restaurées en ciment, en plâtre et endommagées par l'intervention de matériaux non appropriés. A présent se pose le problème de ne pas effacer ou déraciner ce qui a été realisé ; la question de la couverture à Pompei doit être étudiée avec soin. Chaque aspect de la question doit être envisagé dans sa globalité. Il est impossible d'envisager la solution au pro-

blème de la ville de Vetti, qui doit être approfondie, sans prendre en considération la *domus* toute proche. Il s'agit donc de protéger le site en soi de façon efficace tout en tenant compte également des interventions effectuées précédemment, des toitures, des protections historiques ou autres.

Lavagne: Je voudrais proposer un autre exemple qui me paraît répondre à la question que vous venez de poser. C'est celui de la villa de Desenzano dont les fouilles se sont étendues sur de très longues années, depuis celles effectuées par Mirabella Roberti. Les constructions de protection ont été, dirais-je, bâties au cours du temps et les dernières, qui ont fait quelques fois un peu sourire, avec leurs formes de globe, de minarets vaguement orientaux, sont venues en quelque sorte compléter des protections qui existaient déjà. Il aurait été évidemment impossible au début, ne connaissant pas l'étendue de la villa de concevoir un programme d'ensemble. Vous aimeriez avoir, si je vous ai bien suivi, une unité dans les couvertures, que l'on fasse appel par exemple à un architecte qui pourrait en décider les grandes lignes. Mais la plupart du temps, les fouilles avancent petit à petit et l'on doit inventer au fur et à mesure des systèmes de protection qui parfois ne sont pas cohérents entre eux.

Stanley-Price: I would like to thank Alessandra Melucco for a very interesting talk, which raises a large number of the leading issues to do with the philosophy of *in situ* conservation, and I would like to take up one point in particular. When she talked of the need for studies of the success and failure of different types of solutions on archaeological sites with mosaics, and referring specifically to a topic which we have just been discussing — the erection of protective roofs — sometimes I think it's important when we talk about this subject to keep a distinction in mind between protective roofs and protective enclosures, because often there are walls as well, which presents an entirely different type of solution. And the need that I see as being very great, and falls in line with what Dr. Melucco was saying, is to make available the experience that exists — or if it does not exist, it can be very easily acquired — on the effect of erecting a roof or shelter or an enclosure over or around a mosaic on the local climate, meaning the local climate within the area of the mosaic. I know of several cases where people have done studies monitoring the climate under the roof, outside, but very few were ever published. And I think for many other sites where roofs and enclosures have been built in the past, studies need to be made of the effects of those roofs. It is not very difficult work to undertake; many people are trained in climate monitoring — for instance, in museum conditions; it is not quite as simple, but it is not work that requires a lot of laboratory analysis, for instance. And I think there is a great need to acquire more of these data, to publish data that people have already acquired. It often does not make a very long or elaborate study, but I think it is the sort of information, for instance, that could be published in the Bulletin of this Committee, in order to get a better idea of the effects of constructing a roof or an enclosure around a mosaic or any other type of archaeological remains. And I think in that way, looking at the results of those studies on the modification — and it usually is a modification — of the local climate, and putting those

within the context of an analysis of the state of the mosaics which have been protected, and we have to recognize that many mosaics have been much improved, or at least their conservation status has not worsened as a result of the roof. And yet in other cases we know that apparently the condition of mosaics has worsened as a result. I think gradually we will be able to put together a body of data which would, therefore, help in the design of protective roofs and enclosures in the future.

Melucco Vaccaro: I am completely convinced by the opinion expressed by Nicholas, and I think that one of the aims of this congress should be to choose significant cases to study in a very direct way, examining the effectiveness of the roofing. Monitoring should be correctly performed so that indicators provide an accurate comparison between conditions before, during, and after intervention on a certain site, and also allowing comparison with results on other sites. My hope is that as a result of this congress, we can make a proposal with regard to some particularly recommended and significant cases where an intervention may be undertaken, a pilot intervention which should be monitored carefully.

Skaf: Je voulais juste dire qu'au Liban, au lendemain de la guerre, la Direction Générale des Antiquités s'est retrouvée avec de nombreux sites de mosaïques oubliés depuis longtemps, ayant souffert de vols, de vandalisme, etc. La politique adoptée, qui n'était pas idéale mais plutôt la seule vu l'absence totale de fonds et de gestion, fut de réenterrer certaines des mosaïques, au détriment du tourisme et de l'esthétique du site. Mais il s'agissait de limiter les dégâts et de protéger ce qui reste. C'est la politique que nous avons adoptée sur les sites de grande importance où les mosaïques sont en train de disparaître rapidement. C'est une situation un peu regrettable mais nous faisons cela en attendant de pouvoir gérer notre patrimoine de façon plus appropriée.

Melucco Vaccaro: Madame, je crois que les conditions de la récupération et de la sauvegarde des mosaïques des sites anciens du Liban sont une provocation positive que vous présentez à la compétence et à l'histoire de la conservation en général du monde, de notre monde. Les antiquités sont importantes pour l'histoire de tous les pays. Même dans des conditions difficiles, il y a des aménagements, des bâtiments nécessaires qui, s'ils ne sont pas réalisés, peuvent effacer complètement l'histoire et les racines de ce pays. Alors, je crois que c'est dans cette direction que votre pays doit aller, si cela n'a pas encore été fait. (En Italie, il existe des liens de coopérations entre les diverses institutions). On a dit que les facteurs anthropiques causent le plus des dommages et nous privent des ruines de notre passé ; nous en faisons aujourd'hui une expérience amère et directe. Les conservateurs, au sens large, doivent contribuer à résoudre cette situation. On demande à la conservation de trouver un équilibre entre les valeurs. Il faut affronter les causes difficiles là où notre civilisation, notre culture, la culture des opérateurs, des témoins des valeurs de l'Antiquité sont mises en question.

Skaf: Vous entendez dire promouvoir, c'est-à-dire, nous aider à gérer notre patrimoine ?

Melucco Vaccaro: Évidemment.

Skaf: Vous entendez bien dire, à long terme.

Melucco Vaccaro: Je crois que la racine des problèmes que vous rencontrez est commune à d'autres régions du monde. Il s'agit de trouver un équilibre entre les aménagements nécessaires et les exigences actuelles et historiques. Trouver cet équilibre est un véritable défi, dans le sens le plus positif du terme, et ce même dans des contextes moins dramatiques et moins difficiles. Nous connaissons, nous aussi, ces problèmes. Il y a chez nous des politiques d'aménagement dont je ne citerai qu'un exemple : la modernisation exige le passage du chemin de fer. Souvent la conception du projet n'est pas compatible avec la qualité du paysage culturel. Pour cela, nous devrions travailler ensemble pour confronter les cas qui se posent dans le bassin méditerranéen. Votre cas est notre cas à tous.

Ben Abed: Depuis quelque temps, effectivement, on parle de ce problème de politique générale. On nous parle de complexité, nous découvrons les uns et les autres dans la pratique quotidienne, la complexité du problème de la conservation, de la préservation, de l'étude de la conservation et de la préservation. En tant qu'archéologues on a l'impression d'être un peu dépassés. Nous ne pouvons plus affronter la situation seuls car nous nous heurtons à une question de politique générale, de vision globale qui nous dépasse. Nous sommes interpellés en tant qu'individus, mais que peut-on faire individuellement ? Tout cela nous dépasse et, à ma connaissance, un mouvement de sensibilisation des pays riches en la matière est pratiquement inexistant. Ce n'est que l'année dernière lors de la conférence sur la Méditerranée organisée par le Getty où pour la première fois nous nous sommes retrouvés face à nos responsabilités. La question que je me pose et que je pose devant tous mes collègues est la suivante : combien de pays ont mis au point une politique de préservation de la mosaïque en général ?

de Guichen: Je vais me joindre au chœur général pour dire que j'ai beaucoup apprécié l'intervention d'Alessandra Melucco, l'équilibre dans son intervention. Et je pense que le comité arrive justement à un point d'équilibre intéressant. Quand on a commencé en 1977, Henri Lavagne était présent, il s'en souvient très bien, la Conférence, plutôt le type de Conférence était important. Elle s'intitulait "Détérioration et Conservation" . A l'époque on a beaucoup parlé de détachement car le chiffre qu'avait donné Claude Bassier de 95% des mosaïques en France détruites lors de leur découverte fut un choc. Il semblait que la seule façon de les sauver était de les détacher. Il y eut un véritable mouvement, je dirais extrémiste, dans ce sens. La deuxième Conférence s'intitulait "Sauvegarde". On envisageait déjà quelque chose d'autre que le détachement. La troisième s'appelait "Conservation *in situ*". La troisième, la quatrième et la cinquième. On a commencé à vouloir garder *in situ* sans

pour cela bien préciser s'il s'agissait, comme l'a dit Giora Solar tout à l'heure, de détacher ou non. C'était encore confus dans toutes les interventions de l'époque. Et puis, la dernière conférence, "Conservation, Protection et Présentation". Et aujourd'hui pour la première fois, je dirais que le pendule est revenu à sa place au juste milieu. On a commencé à penser à la présentation. Il faut trouver un équilibre, Madame Melucco a parlé de balance, d'équilibre, la balance entre deux pôles. Nous voulons protéger et diffuser. Et là, pour la première fois à Conimbriga on a trouvé cet équilibre entre conservation, protection et présentation. On commençait à percevoir que la mosaïque était porteuse d'un message qu'il fallait diffuser. Je crois que la Conférence va dans cette direction. Chacun d'entre nous doit faire preuve d'un peu d'imagination et comprendre que l'objectif est "mosaics make a site". Il convient de nuancer car il ne sera pas toujours possible de conserver les mosaïques sur place. La bonne volonté et le travail d'équipe sont fondamentaux. Il est tout-à-fait réconfortant qu'autant d'archéologues aient pris part à cette Conférence et il serait intéressant que tout intervenant précise non seulement nom et origine mais aussi s'il est archéologue, restaurateur, scientifique ou architecte.

Lavagne: La sagesse des pères fondateurs, Gaël. Donc, on arrive à un équilibre des propositions.

Badawi: Allora, preferisco fare la domanda in italiano, mi esprimo meglio. Volevo tornare alla domanda fatta dal collega che ha proposto che i restauratori debbano essere gli specialisti che seguono lo scavo direttamente. Allora, c'è anche un altro problema; per esempio, a Beirut, nello scavo che ha fatto la Dott.ssa Leila Badre nella chiesa di San Giovanni degli Ortodossi ha trovato due strati diversi nell'abside della chiesa bizantina. Sotto ha trovato un mosaico romano. In casi come questo, se noi non vediamo quello sotto, restauriamo solo quello sopra; nel frattempo sappiamo che c'è il resto di un altro mosaico sotto l'abside. A questo punto è difficile dire che dobbiamo proteggere solo quello che vediamo in superficie e non anche quello subito al di sotto. Infatti, ci sono tanti casi in cui sono stati trovati da M. Piccirillo tre strati di mosaici uno sull'altro in Giordania. In questo caso, qual è la filosofia? Quali sono le vostre proposte per proteggere un mosaico *in situ*?

Melucco Vaccaro: On a fait référence à l'histoire de la peinture murale parce que c'est de là que nous tirons notre expérience depuis quelques années. Lorsqu'on doit conserver ou détacher des peintures en stratification complexe (et évidemment ce n'est pas ici qu'il faut en décider), il s'agit d'une décision importante et complexe qui doit reposer sur une évaluation des finalités, des urgences et des nécessités du site. Le but final est la préservation et la présentation maximum avec l'emploi des moyens les plus appropriés. La tradition de la peinture murale est un enseignement ; il n'y a rien de nouveau à inventer. C'est une source importante d'expérience lors de cas douteux et complexe comme celui qui a été présenté. Les fresques et les peintures murales sont là pour nous rappeler la ligne à suivre. Les fresques, la situation des peintures est là pour nous indiquer qu'il faut trouver des solutions dans ce sens.

Michaelides: Along the same lines as Dr. Badawi. The main difference we have between frescoes and mosaics, however, is the fact that when you remove a layer of fresco, you are just removing it. It is purely for aesthetic or art-historical reasons that you do it. But if you are an archaeologist and you are excavating, you often need to lift the mosaic in order to be able to date it. Whether there is another mosaic underneath, it does not matter. What we need is a sealed stratum which is under the mosaic. So, it is an important aspect of mosaic conservation *in situ* that we have to bear in mind.

Melucco Vaccaro: My opinion and my experience are that nothing good comes to a monument when you confuse the role of knowledge and the role of conservation, because they must conflict sometimes, and in fact they conflict many, many times. If I need to ascertain the chronology of a monument, I must do it by using the less destructive measures and means that technology, experience, archaeology and science can provide. In the past, we used surgical instruments to obtain knowledge; now, perhaps, we have to turn to other, softer methods to find out what is needed about the history and the chronology of our monuments.

Georghiades: I am very glad there are so many archaeologists here at this conference which is on conservation, and it seems that they are very interested in the conservation of mosaics. And I wonder how far they can interfere with the conservators in the conservation of the mosaics.

Michaelides: Along the same lines as Dr. Bader... The main difference we have between frescoes and mosaics, however, is the fact that when you remove a layer of fresco, you are just removing it. It is purely for aesthetic or art-historical reasons that you do it. But if you are an archaeologist and you are excavating, you often need to lift the mosaic in order to be able to date it. Whether there is another mosaic underneath it does not matter. What we need is a sealed stratum which is under the mosaic. So, it is an important aspect of mosaic conservation too that we have to bear in mind.

Melucco Vaccaro: My opinion and my experience are that nothing good comes to a monument when you confuse the role of knowledge and the role of conservation, because they must conflict sometimes, and in fact they conflict many, many times. If I need to ascertain the chronology of a monument, I must do it by using the less destructive measures and means that technology, experience, archaeology and science can provide. In the past, we used surgical instruments to obtain knowledge; now, perhaps, we have to turn to other, softer methods to find out what is needed about the history and the chronology of our monuments.

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Patrick Blanc et Laurence Krougly

La basilique épiscopale de Xanthos (Turquie). Problématique de conservation *in situ* et de coopération*

L'ancienne capitale de la Lycie, située au bord de la rivière Xanthe, conserve de nombreux vestiges dont les plus anciens remontent au 8e siècle av. J.-C. Dominant toute la plaine côtière, elle eût un rôle prépondérant aux époques hellénistique et romaine. Des fouilles importantes y furent menées dès 1838 mettant au jour divers monuments et de splendides sculptures, notamment le monument des Néréïdes et plusieurs piliers funéraires qui ont fait la renommée du site [1].

Les murs d'une grande basilique épiscopale paléochrétienne ont toujours affleuré. Aux premiers sondages pratiqués sous l'abside dans les années 50 ont succédé à partir de 1970 des fouilles systématiques et des campagnes d'étude dirigées par Jean-Pierre Sodini, dont la publication de synthèse est en cours de préparation [2]. Le relevé et l'étude des pavements font l'objet d'une recherche particulière confiée à Marie-Patricia Raynaud [3].

La basilique (Fig. 1) se présente comme un vaste édifice, d'une surface totale de près de 2300 m², composé d'une large nef centrale aboutissant à une abside occupée par un *synthronon*, deux bas-côtés, un narthex précédé d'un *atrium*, un baptistère et diverses salles annexes. L'ensemble conserve plus de 600 m² de pavements en place, mosaïques (Fig. 2) et *opus sectile*.

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* Ce texte est le résultat d'une réflexion commune, élaborée à partir d'un travail que nous menons depuis 1993 à Xanthos en Turquie.

[1] Depuis 1950, une mission archéologique française étudie le site de Xanthos-Letôon sous la direction de Pierre Demargne, puis d'Henri Metzger, de Christian Le Roy et, depuis 1996, de Jacques de Courtils.

[2] J.-P. Sodini, "Une iconostase byzantine à Xanthos", dans *Actes du Colloque sur la Lycie antique* (*Bibl. IFEA* 27), Paris 1980, pp. 119-148; J.-P. Sodini et L. Buchet, "Réoccupation médiévale d'édifices religieux paléochrétiens: les cas de Xanthos (Turquie) et Qal'at Sem'an (Syrie)", dans *L'identité des populations archéologuiqes*. Sophia-Antipolis 1996, pp. 367-388; J.-P. Sodini, "Les églises de Xanthos", *Dossiers d'Archéologie* 239, décembre 1998, pp. 74-79.

[3] M.-P. Reynaud, *Les mosaïques de la basilique épiscopal de Xanthos, Turquie* (Diplôme d'Etudes Approfondies, soutenu en 1992 à l'Université de Paris I-Sorbonne nouvelle, sous la direction de J.-P. Sodini); *eadem*, "La composition en croix de U dans la mosaïque de pavement", *RA* 1996/1, pp. 69-102; *eadem*, "Les pavements de la basilique épiscopale", *Dossiers d'Archéologie* 239, décembre 1998, pp. 80-83.

HISTORIQUE DE L'INTERVENTION DE CONSERVATION

Lors de chaque campagne de fouilles, les sols ont été dégagés, nettoyés, consolidés puis réenfouis sous une couche de sable. Outre ces consolidations, des opérations ponctuelles (déposes suivies de remises en place de fragments) ont été réalisées par une première équipe de restaurateurs menée par Marc Dupage. "Prémices" de la conservation préventive tant souhaitée sur chaque site, cet entretien annuel a permis un contrôle régulier des mosaïques qui présentaient lors de notre arrivée, près de vingt ans après le début des fouilles, un état de conservation relativement satisfaisant.

A la fin des travaux archéologiques sur le terrain, plus ou moins synonyme d'arrêt de l'entretien annuel, les responsables de la mission ont ressenti la nécessité d'élaborer un projet de consolidation des sols de la basilique et de le mettre en œuvre rapidement sous la direction de spécialistes. L'afflux de touristes, chaque année plus nombreux sur le site à tenter de repousser du pied la couche de sable peu épaisse recouvrant les pavements afin d'entr'apercevoir quelques motifs figurés, et, surtout, le développement de la végétation, dont une prolifération de chiendent observée en de très nombreux points, ont notablement accéléré le processus de détérioration des pavements par l'agrandissement des fissures, l'infiltration de terre et de sable, le soulèvement de petites plaques de mosaïque.

A la suite d'un premier séjour ayant permis d'effectuer un état des lieux, un projet a été établi en 1992, tenant compte des particularités du site, du contexte socio-économique local et des disponibilités matérielles et financières de la mission française.

PRINCIPES

Dans le cahier des charges, furent relevés les multiples facteurs spécifiques à ce site:

- l'adhérence satisfaisante des pavements à leur support,
- les très importantes superficies concernées,
- l'arrêt de l'exploration archéologique de l'édifice,
- l'absence d'un lieu d'accueil (musée ou réserve) permettant d'exposer ou d'entreposer les pavements, et l'absence de moyens pour en créer,
- enfin, la volonté de conserver la cohérence et l'aspect monumental de cet ensemble décoratif.

En raison de ces différents éléments, il nous a semblé important d'envisager avec précaution les solutions radicales telles que la dépose.

L'un des principes directeurs de notre intervention fut la priorité donnée à la conservation *in situ* des mosaïques et à leur mise en valeur dans leur contexte archéologique, les mesures prises servant essentiellement à empêcher, ou pour le moins à retarder — ce dont nous sommes tous conscients — les détériorations suivant la mise au jour de vestiges archéologiques.

Nous avons souhaité une intervention minimale, qui respecterait ce que Federico Guidobaldi définissait lors de notre réunion de Soria en 1986 comme "une image authentique qui suscite des observations et des réflexions infinies et nous replonge avec for-

ce dans notre histoire" [4]. Ainsi donc, les déformations des sols provoquées par la destruction du bâtiment seront conservées, témoignages de l'évolution historique du site.

De plus, et comme dans nombre de pays, devant le développement d'un tourisme de masse occupant une place de plus en plus importante dans l'économie nationale, la Direction des Antiquités souhaitait qu'une présentation au public soit intégrée au programme de conservation. Par conséquent, les interventions se devaient d'être orientées vers une réelle présentation didactique, rendant claire l'articulation du plan du bâtiment avec ses décors de sols, tout en permettant un contrôle facile malgré le passage de visiteurs.

RÉALISATIONS

Six campagnes ont été programmées avec une équipe composée de deux restaurateurs français et d'une dizaine d'ouvriers possédant l'expérience des fouilles. La présence d'une mission archéologique annuelle sur le site de Xanthos-Létoôn permettait d'assurer un support logistique efficace.

Le programme entrepris en 1993 reprend les techniques spécifiques de la conservation *in situ*: nettoyages (Fig. 3), blocages, comblements et infiltrations au moyen d'un mortier de chaux hydraulique, de sable et de terre cuite concassée, parfois additionné d'une faible part de ciment blanc; dépose et remise en place de fragments désolidarisés de leur support (Fig. 4); lutte contre la biodétérioration; réenfouissement (gravier nettoyé du Xanthe, film synthétique et sable propre, sur une épaisseur de 35 cm).

Le nettoyage attentif, zone après zone, de ce très vaste ensemble a permis la découverte de traces d'un chancel disparu dans le bas-côté nord et la mise au jour de fragments de mosaïque appartenant à un état antérieur. Les empreintes d'un *opus sectile* ont également été dégagées au cours de nos travaux dans la nef centrale, à la suite de la dépose de fragments d'un panneau descellés par le chiendent.

A mi-parcours, trois séjours sur le terrain nous permettent d'évaluer à leur juste mesure les différents paramètres techniques et déontologiques liés à ce type d'opération.

Le sauvetage des pavements dans un tel contexte nécessite un contrôle rigoureux de l'environnement: maîtriser la végétation alentour mais aussi empêcher le passage, onze mois sur douze, de chèvres et moutons mettant à mal murets et mosaïques patiemment restaurés chaque année. Par là même, vouloir sauver les pavements demande de développer l'intérêt de la population locale pour les vestiges.

Si, à l'origine de notre intervention, seule la conservation des pavements était envisagée, nous nous sommes vite rendus compte que celle-ci ne pouvait être menée à bien sans une réflexion globale sur la préservation et la présentation finale de l'ensemble du monument et de son décor.

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[4] F. Guidobaldi, "La restauration *in situ* des pavements en *opus sectile*", dans *"Conservación in situ". Soria 1986* (*Mosaics* 4), Soria 1986, p. 169.

Une étude est actuellement menée par un architecte, en accord avec les responsables de la fouille et nous-mêmes, afin de couvrir une partie des galeries de l'*atrium* et d'offrir une vision des pavements à partir de terrasses naturelles situées à l'extérieur du bâtiment. Le remontage de la porte axiale séparant le narthex des nefs, ainsi que la consolidation des murs, accentueront la lisibilité du plan. Seules les mosaïques sous abri seront visibles; sur les autres sera maintenue la protection que nous avons mise en place dès 1993.

Avec les couvertures notamment, s'est posé le problème en terme de "transfert de technologie". Loin de se contenter de construire des structures quelles qu'elles soient, il faut aussi prévoir leur entretien, qui devra être assuré à long terme par les services locaux. Cela nous entraîne à une grande prudence face aux théories et perceptions occidentales. Une sensibilisation aux réalités économico-sociales est indispensable afin de bien percevoir l'association étroite entre l'individu et la technique qu'il utilise, symbiose qui impliquera un engagement personnel réel. Seul, le sentiment d'appropriation des vestiges permettra leur respect et la volonté de leur mise en valeur.

Nous avons souhaité mettre en œuvre à Xanthos des traitements simples, qui soient compatibles avec une main d'œuvre locale non qualifiée et temporaire. Il serait vain de nier les difficultés rencontrées dans ce domaine, notamment le changement régulier des ouvriers mis à notre disposition, nécessitant, chaque année, d'intégrer à notre programme une phase de formation d'une nouvelle équipe aux rudiments de la conservation.

Dans ce cadre, il nous a paru important de choisir, tout au long de notre travail, des matériaux disponibles localement, autorisant non seulement d'éventuelles remises en état, mais aussi toute une prise en charge par un personnel souvent démuni. Des essais ont été effectués se révélant plus ou moins fructueux. Par exemple, nous avons rencontré certaines difficultés, d'année en année, à être livrés en sable d'une qualité constante. Diverses chaux ont également été testées, de même en ce qui concerne les matériaux de réenfouissement.

En revanche, il a fallu opter pour l'importation d'herbicides et de liant pour les mortiers de consolidation. Ces matériaux, bien que disponibles sur place, ont été gracieusement mis à notre disposition par des entreprises françaises (Lafarge-Coppée et Ciba-Geigy). La conservation d'un ensemble couvrant de si importantes surfaces constitue une grosse charge financière. Aussi, de telles opérations obligent parfois à rechercher des sponsors privés.

A l'heure actuelle, de plus en plus de pays demandent, à juste titre, que la conservation des vestiges mis au jour soit prise en compte dès l'établissement d'accords bilatéraux de recherche archéologique, allant parfois jusqu'à justifier par la conservation ces accords de coopération scientifique. Cependant la part de budget qui lui est allouée est trop souvent encore considérée par les responsables de fouilles comme autant de retenues sur leurs propres travaux. Aussi, la conservation, faute de crédits suffisants — car pour être efficace il est indispensable de prévoir des missions longues sur le terrain, — se borne à la protection de quelques vestiges sans prendre en compte l'ensemble des problèmes.

Or, il ne s'agit plus de mener une politique à brève échéance, qui satisferait notre "bonne conscience" et ferait "plaisir" aux autorités locales, mais d'élaborer un véritable programme de conservation à long terme. D'où, dans certains cas, la nécessité de proposer le réenfouissement, qui est trop souvent perçu comme une solution "frustrante" alors même qu'elle ne présume pas du futur des pavements (Fig. 5).

La conservation *in situ* doit être considérée avec sérieux comme une vision du futur, portée par des mesures prudentes ne compromettant pas une éventuelle "reprise des choses".

Certes, l'effort doit porter sur la responsabilisation et la prise en charge de la conservation au niveau national sinon local, ainsi que sur la responsabilisation des organismes internationaux intervenant dans ce domaine. Mais une fracture sociale et culturelle existe entre des restaurateurs formés aux techniques de pointe et d'autres restaurateurs, locaux, ne possèdant pas toujours, loin s'en faut, les moyens matériels nécessaires pour sauvegarder les innombrables pavements dont ils ont la responsabilité.

Dans ce sens, nous pensons qu'il serait bon, lors des campagnes de fouilles à l'étranger notamment, de sensibiliser les responsables et le personnel local à la conservation *préventive* et d'opter dès l'ouverture d'un chantier pour un programme de conservation et de maintenance du site, plutôt que de multiplier les interventions ponctuelles de fin de chantier.

Pour cela, il est indispensable que les accords de coopération se transforment en véritable partenariat. Il y va d'un changement de mentalité des conservateurs de sites archéologiques, des chercheurs nationaux ou étrangers, des bailleurs de fonds, mais aussi de nos propres ateliers.

Nous ne devrions pas mettre en place notre seule technologie, mais nous plier aussi aux besoins du pays et développer les moyens locaux, personnel et matériel. Partageons notre savoir, recherchons des techniques de conservation *in situ* appliquables à de vastes étendues de mosaïques.

DISCUSSION

Lavagne: Nous sommes au coeur du sujet avec l'exemple très précis d'un grand site archéologique qui mérite évidemment beaucoup de soin et je crois que Patrick Blanc a très bien fait sentir les difficultés, en particulier, qui tiennent au pays même où se déroulent les fouilles et les problèmes de conservation qui en découlent. Je suis sûr qu'il y aura des questions à lui poser en particulier sur ce nécessaire accord qui doit s'établir entre les archéologues qui fouillent et qui ont tendance à privilégier la fouille et l'étude scientifique et qui oublient ou ont tendance à oublier quelquefois les impératifs du tourisme.

Melucco Vaccaro: Quand Patrick Blanc mentionnait les difficultés concernant le niveau des professionels, surtout les locaux, on pourrait envisager un 'training' spécifique pour remplir cette lacune en vue d'un échange plus riche entre les différentes traditions, les différentes compétences des techniciens de part en d'autre, comme dans l'exemple qu'il a très bien traité d'une mission étrangère.

Krougly: Il se trouve que c'est une fouille qui a démarré dans les années 70 et je pense que ce n'était pas encore envisagé à l'époque.

de Guichen: A propos du chiffre. Est-ce qu'on peut en avoir une idée — parce qu'autrefois on parlait de mosaïques d'un mètre carré, mais il me semble qu'il s'agit ici de quelques centaines de mètres carrés — pour donner à ceux qui n'ont pas eu cette expérience, une idée du temps, de l'argent, du nombre de mois, de personnel que vous avez dû employer ? Est-ce que vous êtes tous restés un an ou cela a-t-il duré davantage ? Avez-vous de telles données ? Je crois que nous sommes en train d'accomplir un pas très important. Autrefois, on parlait de la tesselle, puis on a parlé de pavement, maintenant on parle de surfaces qui font plusieurs centaines de mètres carré. Ce matin, un collègue parlait de 8.000 mètres carrés de pavements en mosaïque. Quand on commence à parler de gestion de sites, ces chiffres ne doivent pas nous effrayer.

Krougly: Je pense què le terme de gestion de sites est encore un peu exagéré pour cette mission. Nous devons souligner un problème concernant le personel qui nous aide. Ce sont des paysans qui travaillent sur place trois semaines ou un mois par an avec nous. Et pour des raisons locales, l'équipe change souvent ; donc il n'y a pas de véritable planification ni de façon de procéder comme on le souhaiterait. Notre projet essentiel est de bloquer les mécanismes en cours pour que les mosaïques ne s'abîment pas davantage, et ce à la demande de la personne qui a fouillé cette basilique qui a voulu laisser une situation "propre".

Ben Abed: Je voudrais poser une question à Patrick Blanc. Il semble que, dans le cadre de cette mission, il y ait eu un effort de restauration et de suivi. La question que je pose est la suivante : lorsque cette mission sera terminée, lorsque tous les archéologues, les conservateurs seront partis, est-ce qu'il y a un engagement de la part du pays de continuer le travail et l'entretien ? Si on va aboutir d'ici dix ans à ce que toutes ces mosaïques se remettent à jouer — pourquoi faire reculer l'échéance ?

Blanc: Pour le moment, cela n'est pas prévu. Pour cette raison, on a recours au recouvrement et au réenfouissement des mosaïques.

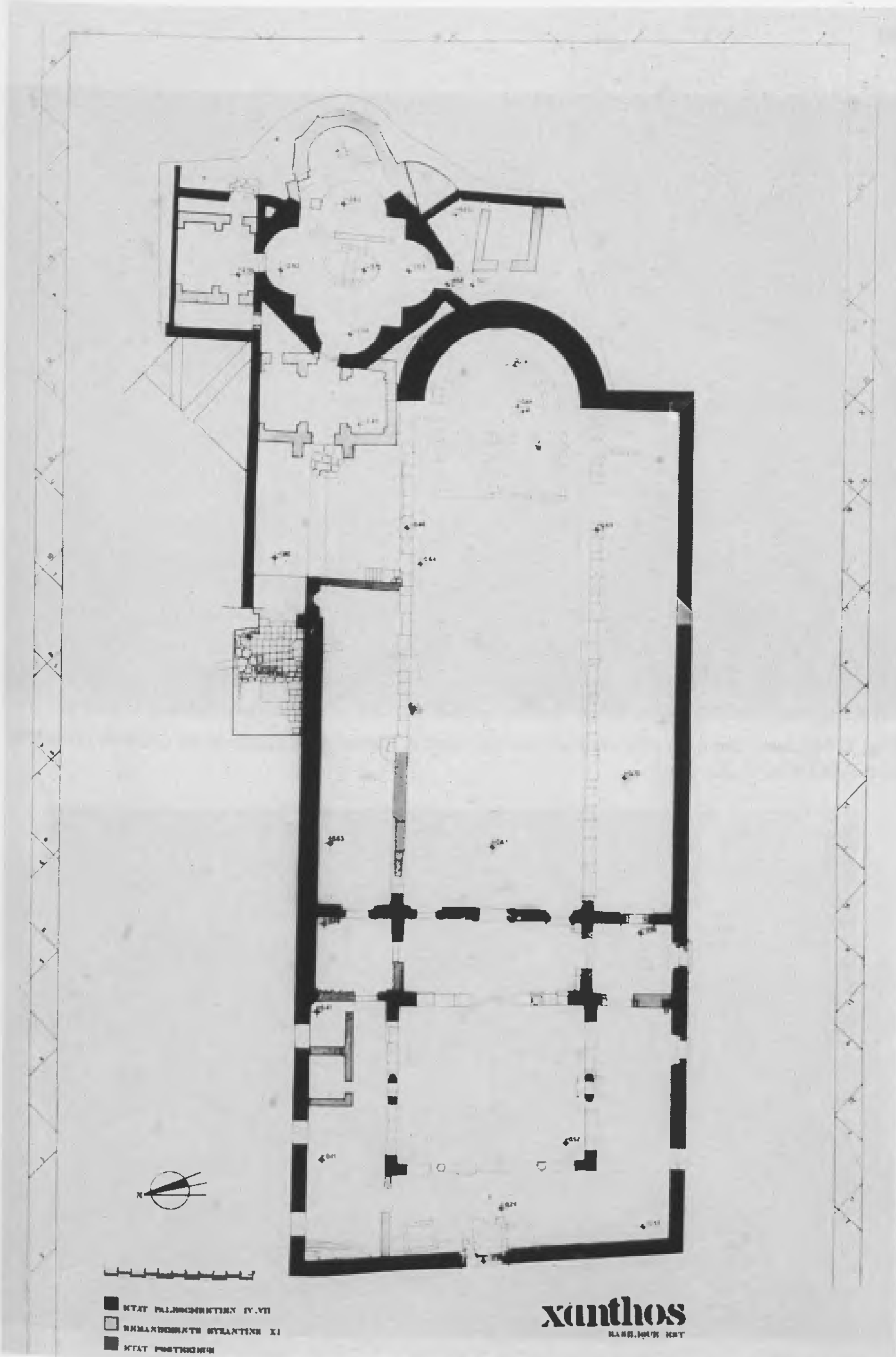


Fig. 1: Plan de la basilique épiscopale (J.-L. Biscop).



Fig. 2: Nef nord, panneau avec cerfs affrontés de part et d'autre d'un canthare, en cours de consolidation (Cliché M.-P. Raynaud).



Fig. 3: Atrium, panneau géométrique en cours de nettoyage (Cliché M.-P. Raynaud).





Fig. 5: Vue générale du site après recouvrement des sols (Cliché P. Blanc).

Anastasia Panayiotopoulou and Stella Raftopoulou

Mosaics *will* make a site: remarks on the excavation and conservation of mosaic pavements at Sparta*

Laconian Studies have been hindered by the textually attested picture of a city legendary for the military competence and ethical values of its citizens. Nevertheless, the amount of archaeological finds, from both rescue and systematic excavations, increasingly contradict this fictional picture. Except for the flourishing Archaic period, excavations have revealed the important Roman phase of the city. Most scholars are familiar with historical aspects of the history of Sparta in different periods, but the archaeology of the respective periods is less well known. Pausanias described in detail the city of the 2nd century AD, but the topography of the city is far from clear. Roman Sparta, studied thoroughly by a few specialists and documented by important finds, is not well known to the wider academic and general public. Rescue excavations yield piecemeal information, so that the layout of the lower city cannot be elucidated. Excavations have revealed some impressive public buildings of Roman date, notably the Stoa [1] and the Theatre [2]; all of them unfortunately are ruined and have not preserved their monumental character, nor their sumptuous decoration. Important finds are not easily comprehensible to the general public. Sculpture is exciting to the connoisseur, but rarely so to the uninitiated, while important inscriptions are difficult to decipher and simply *Greek* to the average museum visitor.

Nowadays the visitor to Sparta can see the extensive archaeological site on the acropolis, a large, low hill where important civic and religious buildings once stood. Some of these buildings were always visible, and have been partially excavated. Although none of these buildings is totally uncovered, this is the main area of Sparta that has attracted the interest of the authorities, and the site is currently under systematic development.

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* We were, unfortunately, unable to attend the conference, but Prof. Michaelides kindly agreed to include our paper in the proceedings. We would like to thank Prof. D. Michaelides for his friendly support, Dr. S.E. Waywell for revising the English text and T. Papadogonas for help with the figures.

[1] G.B. Waywell and J.J. Wilkes, "Excavations at Sparta, the Roman Stoa 1988-91", *Annual of the British School at Athens* 89, 1994, pp. 377-432, with references to earlier excavations.

[2] G.B. Waywell and J.J. Wilkes, "Excavations at the Ancient Theatre of Sparta", *Annual of the British School at Athens* 90, 1995, pp. 435-460, with references to earlier excavations and studies.

Important antiquities lay within the modern town of Sparta as well. The Sanctuary of Artemis Orthia, at the eastern end of the modern town, near the bank of Eurotas, is ruined and in a poor state of preservation.

Proper development of the urban plots, where antiquities are already preserved, will reveal another important but neglected archaeological site, the site of the lower city of Sparta [3]. Impressive features in these plots are mosaics, always among the most exciting finds at any site: colourful and often with figurative decoration [4], particularly lively, they prove the adoption at Sparta of the Roman way of life.

The rapid expansion of the modern city of Sparta has resulted in a dramatic increase in the number of rescue excavations. The peculiar character and nature of rescue enterprises raise a series of problems: it is not possible to keep to a schedule, or to choose the location of any project. The choice of place, the order and speed of work depend on the construction of modern blocks of flats, or much worse on the requirements of public works.

Urgent rescue excavations in Sparta reveal remains of every period, but mostly the lower city in the Roman period. Most of the remains are domestic, and belong to large urban mansions, which unfortunately are often only partially revealed. Nevertheless, a tentative ground-plan for some houses can be reconstructed, with atria and courtyards with gardens, rooms for entertainment (triclinia), domestic quarters, in some cases bathing facilities as well. Occasionally, parts of public buildings are found too. Quite a few of these are decorated with mosaics. Up to now, a total of 145 different mosaic pavements has been unearthed in 102 locations within the city.

Treated analytically, these mosaics cover the whole range from Hellenistic to Early Christian times, with a large majority in the Roman period. To the Hellenistic period date pebble and chip mosaics [5], while to the early Roman period (1st and 2nd centuries AD) date pavements with plain linear decoration and a small range of colours. The increase in numbers during the 3rd century is impressive, without interruption, despite the otherwise attested invasion of the Heruli in 267 AD [6]. All these mosaics form a distinctive group characterized by a wealth of figurative scenes, and multiple versions of geometric motifs. These motifs are typical features of a group, attributed to a local workshop active in Sparta

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[3] Questions about the presentation and function of archaeological sites have been addressed only recently: cf. B. Amendolea (ed.), *I siti Archeologici. Un Problema di Musealizzazzione all'Aperto*, Rome 1995, the Getty Congress in 1996: M. de la Torre (ed.), *The Conservation of Archaeological Sites in the Mediterranean Region*, Los Angeles 1997. Papers on the subject have appeared in the periodical *Conservation and Site Management* (London).

[4] There have been several individual or integrated projects concerning the conservation of mosaics: cf. M. Bedello Tata, L. Spada, R. Nardi and Ch. Zizola, "*Thermae* of the Cisarii: a pilot project as a model for programming and managing conservation", *Newsletter of the International Committee for the Conservation of Mosaics* 10, 1998, pp. 10-21.

[5] The data on the mosaics are to be found in the Ph.D. Thesis of A. Panayotopoulou at the University of Paris X, Nanterre, under the title *Mosaïques de l'époque impériale à Sparte* (in progress). We wish to thank Dr. G. Steinhauer and I. Efstathiou for allowing us to mention unpublished material.

[6] M. Oikonomidou, *Festschrift Orlandos*, Athens 1966, vol. G, pp. 376-382.

at the end of the 3rd and the beginning of the 4th century AD. To this workshop are assigned the majority of the mosaics unearthed in the town, 73 in all. The production of mosaic pavements continued in the late 4th century, in decreasing numbers, until it was interrupted by the invasion of Alaric's Visigoths in 396 AD [7]. Early Christian times saw a revival in mosaic production, with 10 specimens, mostly from large public buildings.

Most of these mosaics have been unearthed in private plots, which have an average size too small for the extent of the Roman mansions. Considering the different orientation of the modern city, it is only by chance that a whole room is found within the border of a single property. Therefore most of the mosaic pavements have been lifted and transported to the museum (Fig. 1). Some 16 pavements have been found in the course of public works, under modern streets and most of these have also been lifted, after excavating the largest possible extent of the room (Fig. 2). Only five of them, fragmentary and located at the edge of the street, or under the pavement, were backfilled after having been recorded in detail.

For the purposes of this paper the mosaics of Sparta are grouped according to their conservation, and their state of preservation. Out of a total of 145 mosaics, 30 are preserved *in situ* (Fig. 3).

The usual justification for conservation is the condition in which the ruins are preserved; the fate of a mosaic is judged mainly on the state of preservation of the pavement and the architectural integrity of the monument. The condition of preservation is usually so good that no special treatment is required. The actual position of the pavement within the modern plot is another factor that conditions *in situ* preservation. Assessment of any historical merit is taken into account, as in the case of buildings that were considered as places of worship. The decision in favour of *in situ* conservation is taken mainly by the local Ephoreia although the final decision is taken by the central administration in Athens.

The Archaeological Service has considered worth buying and conserving nine different plots within the modern town of Sparta: seven of these have mosaic pavements, which have been instrumental in the expropriation. Two of these mosaics decorated public buildings, the majority adorned private houses. Considering both the importance of these pavements and their location within the fabric of the modern city, it is obvious that expropriations have occurred by chance, without any attempt at integration, or any provision for eventual incorporation in a wider archaeological site. The expropriation of land is a procedure that has been abandoned in the past few years, mainly because of the high cost of land. Moreover, expropriation of individual plots in heavily built-up areas causes many problems: the ancient remains, being at a level lower than the modern street, become an area where litter accumulates, there is a lack of sunlight and increased damp causes infections. Eventually, these antiquities are themselves directly endangered. Two mosaics, the first two found last century, were roofed at the time.

An extensive area around the main archaeological site of the acropolis is severely restricted in order to conserve the antiquities that have already been located, but not yet

[7] P.A. Cartledge and A.J.S. Spawforth, *Hellenistic and Roman Sparta. A Tale of two Cities*, London 1989, pp. 125-126.

excavated. Mosaics excavated there are temporarily backfilled with sand, although one that was found in the vicinity of a private school is covered with a shed and occasionally open to the public.

In the exceptional case where a mosaic is found within the boundaries of a property, the Archaeological Service asks for its conservation *in situ*. The level at which Roman antiquities are found is 1 to 2 metres below the present level so that the mosaic is slightly higher than the level of the basement (Figs 4 and 5). Conservation of the mosaic involves the raising of the whole building, a method accepted by the planning authorities. In these cases the mosaic is conserved and well protected, but further agreement with the owner is required to allow access to the basement of the building.

Some mosaic pavements that were located in areas that did not obstruct building or implementation of public works were left *in situ*, protected with a layer of waterproof material and sand. These are all recorded in detail with photographs and plans. Unfortunately there is no physical access to them although archaeologists have access through the eventual publication and the archive of the local Ephoreia. Although these mosaics may be considered well protected, deep in the ground, there is always a chance, especially for those found in the course of public works, that they might be damaged in the course of some unauthorized intervention, an urgent repair for instance.

Mosaics that are lifted are transported to the storerooms of the local museum, awaiting exhibition The decision to lift the mosaic pavement turns the artifact from a feature of an architectural setting into a museum object. Because of lack of space in the Sparta Museum only a small number of mosaics are on display; they are exhibited on the walls and on consolidated frames, all of them with figured scenes, which once formed the central panel of the pavement. This approach is based on the aesthetic value of the pictures, and is therefore wrong. Mosaic pavements allude easily to wall-mosaics and wall-paintings, although these two latter are another category altogether. Similarity of iconography between the two types of antiquities has made this approach acceptable for past generations of archaeologists, when museums were Art Galleries. Nowadays, even those mosaic pavements that are necessarily detached have to be treated as artifacts, having a specific output in domestic architecture and not as echoes of Great Art in a provincial town. A rearrangement of the present exhibition is necessary, and a new museum which will really be a museum to display mosaics, is badly needed.

The protection, presentation and management of the wider archaeological site of Sparta is an issue both broad and complex; this paper concentrates on one particular aspect, pertaining to the topic of this Congress, making specific points that concern the *in situ* conservation of mosaics. Mosaics are part of the integral picture of the Roman city, and eventually, it is this city as an entity that has to be taken into account.

Mosaics preserved *in situ* are actually part of ancient houses, and however fragmentary, they are a direct and physical reference to the past of Sparta. Together with other surviving old buildings, they add to the inherent value of the living past of the area and contribute to the intrinsic sense of the place. They retain the character of open space and relative human scale, lost nowadays among the blocks of flats. The glorious past of Sparta is a source of local pride, but it remains theoretical and abstract; constant interference of the Archaeological Service in construction works translates into delays and loss of mo-

ney. A fresh perspective, that would take into account the social value of antiquities, materializing into practical financial profit, might change the attitude in a spectacular way.

All mosaic pavements on state property or on controlled private land have received the minimum intervention awaiting proper development. They are covered with sand for protection from the elements. Once uncovered, shelters of some form are necessary for the protection of the pavements. Sometimes, in an attempt to eliminate the effect of damp, wind and heat, sophisticated structures cause an adverse microclimate [8]; coverage that would succeed in moderating the extremes of the local climate should be enough. The final objective of any intervention should be an exhibition of the domestic architecture of Roman Sparta. A generic, and therefore ideal, type of shelter should protect the mosaic adequately, by recreating the sense of intimate house quarters. Except for the revived scenery, it is important to interfere successfully among the structures of the living modern city, and integrate the necessary facilities for the development networks of infrastructure, especially electric lighting and water drainage.

There must be provision for the subsequent use of the site: some visitors come for entertainment, others for educational purposes. There must be an overall design development for all aspects during the intervention for the management of the site. Visitor itineraries, pathways, sign-posts and explanatory panels should be developed to take into account guided tours and individual unmonitored tourists.

An integrated approach in managing the archaeological site of Sparta will allow the development of an open, *in situ* museum, a proper, open-air exhibition space. The implementation within a wider project, will help to avoid local and temporary interventions. Archaeological site management, despite the long and costly procedures, is becoming increasingly current; still, it is not a priority [9].

Sparta lacks impressively preserved antiquities and therefore lies outside the main stream of mass tourism which results in considerable economic benefit. The number of visitors to the nearby site of Mistra, the abandoned mediaeval town, should be considered as a relative index of possible visitors to the site of Sparta. Cultural tourism is clearly the trend nowadays, and if effective management strategies are adopted, the neglected site of Sparta may turn into a popular tourist attraction.

This paper provides a systematic analysis of some important antiquities preserved *in situ* and it is hoped that it will form the basis on which further studies and interventions will be based. The acknowledged importance of the *in situ* mosaics at Sparta will hopefully contribute towards an integral management plan, allowing the conservation of

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[8] N. Stanley-Price, "The Roman Villa at Piazza Armerina, Sicily" in M. de la Torre (ed.), *The Conservation of Archaeological Sites in the Mediterranean Region*, Los Angeles 1997, pp. 65-84.

[9] There are many large projects implemented on individual sites (Knossos, Acrotiri) and further proposals for a comprehensive development of urban sites, as the much debated project at Athens, and the project of the École Française d'Athènes for Argos: cf. F. Croissant, "Propositions pour l'aménagement d'un parc archéologique à Argos", in *Argos et l'Argolide, Topographie et Urbanisme*, Athens 1998, pp. 461-468.

new finds. Mosaics conserved *in situ* are the antiquities, which when properly presented, will show off the site, and confirm in the best possible way the title of this Congress.

CATALOGUE [10] (and key to the map Fig. 3)

Mosaics *in situ* on state property.

1. House; two mosaic pavements, representing the abduction of Europe and Orpheus charming the beasts; end of the 3rd and beginning of the 4th c. AD; bb 140, corner of Dioskouron and Palaiologou St., ex-property Mourabas; Waywell 1979, p. 302, no. 46, pl. 51, figs 41-42.
2. House; mosaic pavement representing Achilles in Skyros; beginning of the 4th c. AD; bb 36, Vrassidou St., ex-property Phoustanos; Waywell 1979, p. 302, no. 45, pl. 51, fig. 39.
3. Theatre; two mosaic pavements with geometric decoration; Roman; Woodward 1926-27, p. 240; the second one unpublished.
4. Baths; two mosaic pavements, with geometric and figurative decoration; 1st half of 3rd c. AD; bb 126/127, Triakossion St., ex-property Dipla; *Deltion* 20 (1965) Bl, pp. 173-174, pl. 155c.
5. House; three mosaic pavements with geometric and figurative decoration: Medusa, Dionysos with actor; 2nd half of the 3rd c. AD; bb 123, Alkmanos St.; ex-property Paraskevopoulou; *Deltion* 20 (1965) Bl, pp. 170-173, pls. 153-154.
6. Basilica; two mosaic pavements with geometric and figurative decoration; 1st half of the 6th c. AD; bb 117, Triakossion St; ex-properties Yiatras, Loumos and Kirkiris; Assimakopoulou-Atzaka 1987, pp. 105-106, no. 47, pls. 150-155.
7. House; mosaic pavement representing Orpheus charming the beasts; 2nd half of the 3rd c. AD; bb 140, Herakleidon St., ex-properties Papadimitriou and Nikolettos; unpublished.
8. Baths; mosaic pavement with geometric and figurative decoration; 2nd half of the 3rd c. AD; bb 100, Orthias Artemidos St., ex-property Dikaios; *Deltion* 20 (1965) Bl, pp. 176-177; *Deltion* 22 (1967) Bl, pp. 201-202, fig. 1; *Deltion* 24 (1969) B1, p. 137.

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[10] The following abbreviations are used in the catalogue:

bb: building block.

Assimakopoulou-Atzaka 1987: P. Assimakopoulou-Atzaka, *Corpus of the Early Christian mosaic pavements of Greece. II: Peloponnese-Mainland Greece* (in Greek), Thessaloniki 1987.

Waywell 1979: S.E. Waywell, "Roman Mosaics in Greece", *American Journal of Archaeology* 83, 1979, pp. 293-321, pls 45-52.

Woodward 1923-24: A.M. Woodward, "Excavations at Sparta, 1924-25. 1. Introductory", *Annual of the British School at Athens* 26, 1923-24, pp. 116-118, pls XIV-XXII.

Woodward 1926-27: A.M. Woodward, "Archaeology in Greece, 1926-27", *Journal of Hellenic Studies* 47, 1927, pp. 234-263.

Mosaics *in situ* on private, but restricted property.

9. Baths of Arapissa; three mosaic pavements; Roman; (Magoula); A.J.B. Wace, "Excavations at Sparta, 1906. II. The Roman Baths (Arapissa)", *Annual of the British School at Athens* 11 (1905-06), pp. 407-414, fig. 1.
10. House or Baths; mosaic pavement with geometric decoration; Roman; SE slope of the acropolis; A.M. Woodward, "Archaeology in Greece, 1922-24", *Journal of Hellenic Studies* 44 (1924) p. 260; Woodward 1923-24, p. 118.
11. House, Baths or Gymnasion; one mosaic with geometric decoration; Roman; SW of the Theatre; Woodward 1923-24, p. 118; Woodward 1926-27, p. 241.
12. House; one mosaic in the atrium with geometric decoration; 2nd half of the 3rd c. AD; Alkmanos St., property Polychronakos; *Deltion* 35 (1980) Bl, pp. 136-139, pl. 48.

Mosaics *in situ* under modern buildings, in basements or courtyards.

13. House; one mosaic pavement with geometric and figurative decoration; Roman; bb 120 A, Saketas St., property Georgakoulias; Assimakopoulou-Atzaka 1987, p. 103, n. 91.
14. Baths; five mosaic pavements with geometric decoration; 2nd c. AD; bb 121, Palaiologou St., 2nd Elementary School; *Deltion* 28 (1973) B1, pp. 170-171, fig. 5.; *Deltion* 35 (1980) Bl, p. 135.
15. House; one mosaic pavement with geometric decoration; 4th c. AD; Magoula, property Mandrozos; *Deltion* 27 (1972) Bl, pp. 248, 250-251.
16. Basilica, apsidal room; mosaic pavement with geometric and vegetal decoration; late Roman; bb 31, Kleomvrotou St., property Roumeliotis and Andrakakos; Assimakopoulou-Atzaka 1987, pp. 103-104, n. 91, pl. 143.
17. House; fragments of two mosaic pavements with geometric decoration; 2nd c. AD; bb 137, Herakleidon St., property Kokkonos; *Deltion* 29 (1973-4) Bl, 283-285, fig. 1.
18. House, apsidal room; mosaic pavement with geometric and figurative decoration and wall mosaic in a conch with geometric decoration; mid 4th c. AD; bb 136; Triakossion St., property Alikakos; *Deltion* 30 (1975) B1, pp. 74-76, pl. 44.
19. House; two mosaic fragments with geometric decoration; 2nd half of the 3rd c. AD; bb 135, Agidos St., property Dimitrakopoulos; unpublished.
20. House; one mosaic pavement in the atrium decorated with geometric patterns; 2nd half of the 3rd c. AD; bb 135, Herakleidon St., property Salaris and Kefalopoulos; *Deltion* 35 (1980) Bl, p. 136, pl. 47b.
21. House; four mosaic pavements with figurative and geometric decoration; 2nd half of the 3rd c. AD; bb 40, Dioskouron St., property Salaris; *Deltion* 38 (1983) Bl, pp. 90, 92.
22. House; two mosaic pavements with geometric and figurative decoration; end of the 3rd or beginning of the 4th c. AD; bb 35, corner of Palaiologou and Thermopylon St., properties Minakakis and Valiotis; unpublished.

Backfilled Mosaics (without access).

23. House; four mosaic pavements with geometric decoration; 1st half of the 3rd c. AD; Triakossion St., sports ground site (National Stadium); R.V. Nicholls, "Sparta", *Annual of the British School at Athens* 45 (1950) pp. 282-289, fig. 14, pl. 28.
24. House; mosaic pavements with geometric decoration; late Roman; bb 112, 113, 114, properties Tsouvalis, Varvitsiotis, Tzortzakis; *Deltion* 16 (1960) Bl, p. 102.
25. House; one or more mosaic pavements with geometric decoration; late Roman; bb 114, Hagiou Nikonos St., properties Dimakis, Vamvakitis; *Deltion* 16 (1960) Bl, p. 102.
26. House; fragment of mosaic pavement with geometric decoration; Roman; bb 35; Thermopylon St., near property Valassakis; unpublished.
27. House; fragment of mosaic pavement with geometric decoration; Roman; bb 127, Platanista St.; property Giannakopoulos; *Deltion* 38 (1983) Bl, p. 92.
28. House; pebble mosaic pavement with geometric and vegetal decoration; Hellenistic; bb 113, Triakossion St., near the property Kollias; S. Raftopoulou, "Recent Finds from Sparta", in *Sparta in Laconia,* London (1999).
29. House; mosaic pavement in the atrium with geometric decoration; beginning of the 4th c. AD; bb 118/120a, Dorieon St., near property Mirayias; *Deltion* 47 (1992) B1, pp. 107-108.
30. House; mosaic pavement with geometric decoration; 1st half of the 5th c. AD; bb 120a, Saketa St., near the property Georgakoulias (cf. mosaic no. 13); *Deltion* 47 (1992) Bl, p. 108.

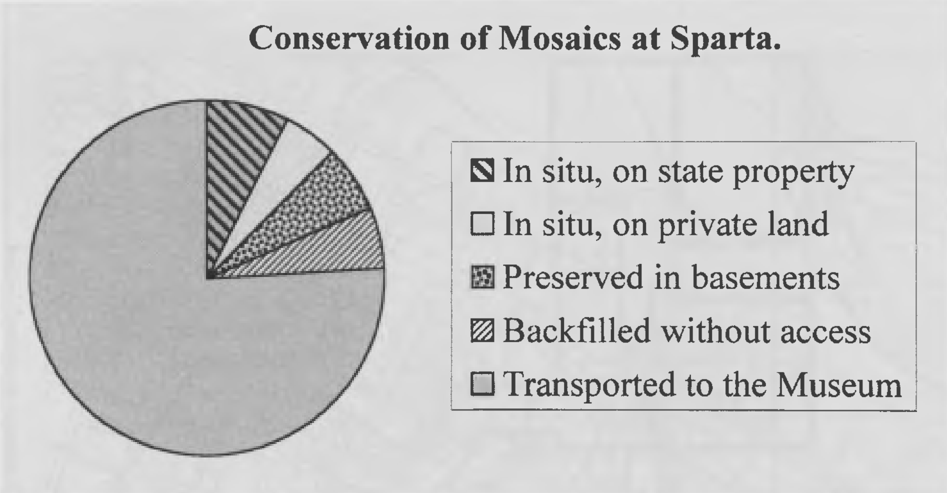


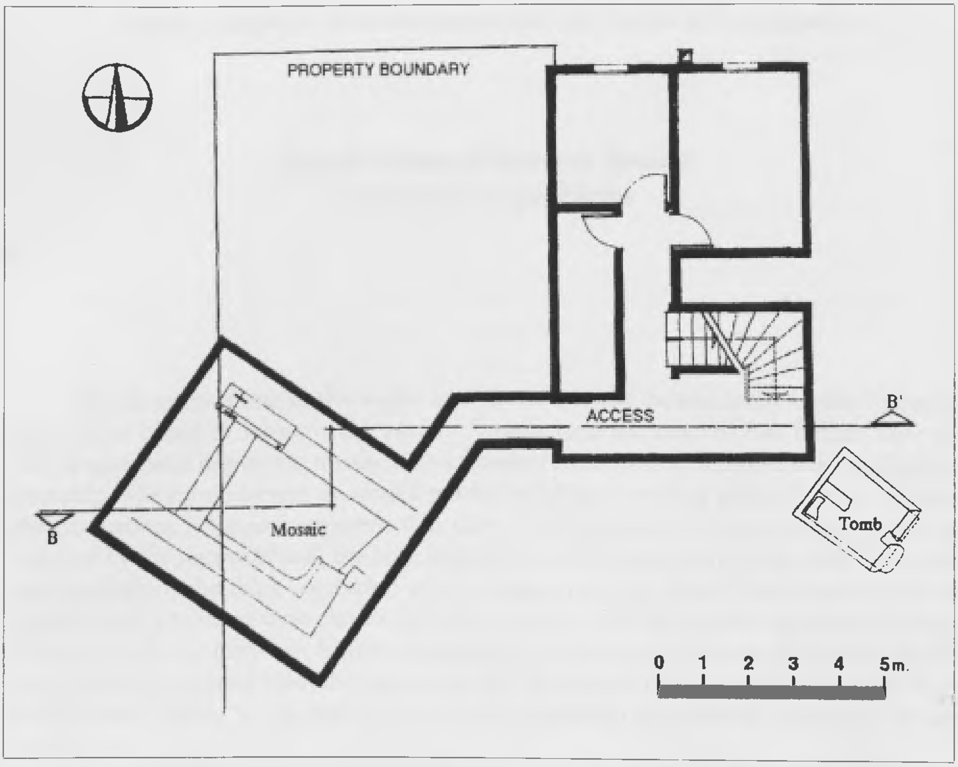
Fig. 1: Chart showing the numbers of mosaics, according to their preservation.

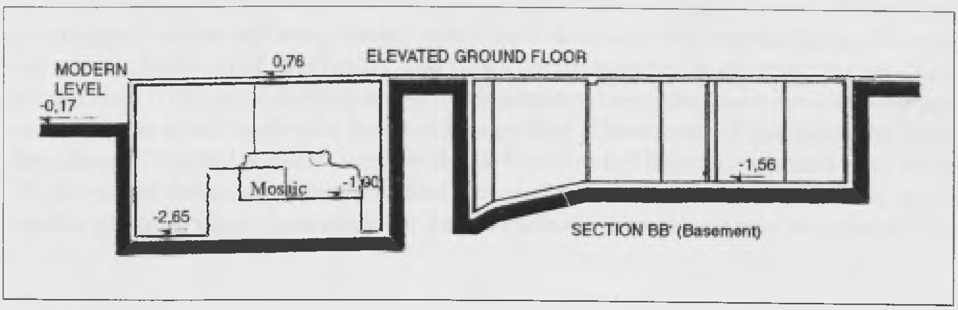


Fig. 2: Roman mosaic decorating a garden found in 1994 at Chamaretou St., lifted and transported to the Museum storerooms.



Fig. 3: Map of the northern part of Sparta, with the locations of the mosaics preserved *in situ.*





Figs 4 and 5: Plan and section of the basement of the block of flats at Herakleidon St., with the mosaic preserved *in situ* (mosaic no. 20).

Vassiliki Yiannouli, Nicoletta Anastasatou and Cleopatra Papastamatiou

Mosaic floors of ancient Samos: conservation problems

Rescue excavations in the wider area of the ancient capital (present-day Pythagoreio) of the island of Samos in the eastern Aegean, near the coast of Asia Minor, have revealed numerous important mosaic floors, some of which are of unique quality and craftsmanship. The mosaics once decorated public buildings as well as private houses. During the excavations it became apparent that there were a number of conservation problems induced by the nature of soil, the high humidity and the proximity of the sites to the sea, and particularly the thick vegetation which characterizes the island. Three mosaics which exhibit these problems were chosen as representative of all the mosaics of ancient Samos. These include the only two hitherto known Hellenistic mosaic floors of a public building (probably a palace) from the upper city and the mosaic of the central nave of the Early Christian basilica in the region named *Tria Dontia* in the western suburb of the ancient city [1].

The excavations undertaken during 1982-1983 on the north slope of the mountain *Spiliani* revealed the remains of an impressive building complex (Fig. 1) dating to the Hellenistic period (3rd-2nd centuries BC). The existence of such a building was not unexpected: earlier surveys, visible remains of ancient buildings, as well as the privileged location with the panoramic view made it quite obvious that in that area was one of the rich suburbs of the ancient capital of Samos.

After a long interruption the research in the area was resumed in 1993 as a systematic excavation. The parts of the building excavated so far are a large *Oikos* or *Andron* (banqueting hall) and an adjoining smaller room, both decorated with mosaic floors. The mosaic of the *Andron* is of rare beauty and superb craftsmanship made with tesserae often smaller than 0.001 m. It consists of a three-dimensional meander and a band of wave patterns with its spirals ending in heads of lion-griffins. The mosaic of the adjoining room has a band of stylized acanthus scroll with leaves and trefoil blossoms within a lotus band. To the east of those two principal rooms there is a series of service quarters, while to the south a group of water cisterns and to the west a monumental fountain were found. The

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[1] Β. Γιαννούλη, "Αρχαία Σάμος: Η περιοχή της άνω πόλης. Στοιχεία τοπογραφίας και η συνέχεια του Ευπαλίνειου υδραγωγείου", *Σαμιακές Μελέτες* 3 (in press).

complex also included a Nymphaeum between the main building and the fountain dating to the archaic period (6th century BC)[2].

The second mosaic floor presented here belongs to an Early Christian basilica with three naves (Fig. 2) in the southwest area of the ancient city. The main excavation took place in the years 1977-1979 but the mosaics that covered the three naves were cleaned and recorded in an additional campaign in 1995. Rich and complicated, mostly geometric patterns made of various kinds of stones and glass paste cover the entire surface of the floors[3].

At present these three mosaics remain covered with wire mesh, *perillite* and gravel in order to protect them. Nevertheless, in spite of these protective measures, each time the mosaics have been uncovered for study purposes, new and more extensive damage has been noted.

The mosaic floor at *Tria Dontia* is located just 30 m from the seashore next to a busy tourist hotel, and it is easily accessible to the hotel's guests. The two Hellenistic mosaics are located on an area of sloping ground at the top of a hill, and they are especially vulnerable to the effects of wind and rain. It should be noted that none of these three floors is protected by a permanent shelter.

All of the above factors contribute to multiple forms of physical, chemical and biological deterioration.

Physical deterioration includes the sinking of the floor at various points, followed by fissuring (Fig. 3), and the subsequent shifting of the sections on both sides of the cracks, especially when the floor is located on an incline. This physical deterioration, in combination with chemical infiltration of the plaster by dissolved salts, leads to a loss of cohesion. As a result, tesserae become detached from the underlying support.

The deleterious effects of various biological agents add to the physical and chemical damage. Fungi leave stains on the surface, and lichens result in both chemical and physical deterioration of the tesserae and of the support. The most significant damage, however, is caused by plants whose extensive root systems undermine the support that lies beneath the mosaics. Plants such as the *caper* and the *palamonides*, both of which grow in abundance on Samos, have root systems that extend horizontally as far as five or six metres away from the plant and cause great damage.

Other causes of damage to the mosaic floors include the destruction of the buildings they originally decorated as well as subsequent reconstruction activity on top of the floors. The latter has resulted mainly in hard deposits of plaster (crusts) which make it impossible to discern the designs of the mosaics. One example is the early Christian mosaic floor at *Tria Dontia*, which was later used as the foundation layer for a new marble inlay floor (*opus sectile*) in the church.

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[2] V. Giannouli, "Neue Befunde zur Wasserversorgung der archaïsche Stadt Samos", *Archäologischer Anzeiger* 1996, pp. 247-257.

[3] For a detailed description see V. Yiannouli, "Τα ψηφιδωτά δάπεδα των παλαιοχριστιανικών βασιλικών στην αρχαία πόλη της Σάμου", in *Acts of the Congress "Η Σάμος από τα βυζαντινά χρόνια μέχρι σήμερα"*, vol. A, Athens 1998, pp. 271-279, fig. 1-4.

A similar problem is caused by salts which crystallize into hard crusts on the surface of the tesserae. The close proximity of the sea makes this a serious problem which has necessitated small-scale maintenance interventions (Fig. 4). This situation will, however, require more drastic and decisive measures.

The field of antiquities preservation in Greece has always dealt with such problems, especially in situations involving problematic locations, by detaching and removing the mosaics from their foundation and then: 1) replacing them in the same location after appropriate measures, such as levelling or waterproofing the ground, have been taken to ameliorate the conditions; or 2) placing them in another location, whether open or enclosed; or 3) placing the detached sections in storage.

With regard to the floors under discussion here, however, such solutions would be unwise and inappropriate for the following reasons:

1. The mosaics are an integral architectural feature of the buildings which they originally decorated. Moreover, the two Hellenistic floors are related thematically to the building which they decorated, since a number of decorative elements in the mosaics appear to have been inspired by corresponding architectural features, such as the *toros* and the imitation of a staircase in the northeastern corner of the mosaic with the acanthus scroll. The option of relocating them to a site free of deleterious factors is thus eliminated.
2. The mosaic in the early Christian basilica is in a deteriorated condition. In this case detachment and subsequent removal to another location would most likely lead to serious problems when reassembling the floor, since it would be impossible to place the detached sections in their identical positions or even in the same relation to one another, even if a complete architectural blueprint had been made before the detachment and could be used as a guide.
3. The mosaics are of exceptionally high quality of craftsmanship and rare and expensive materials were used. The mosaics of the Hellenistic building are characterized by such absolutely precise craftsmanship (Fig. 5) that we are often at a loss to explain how they could have been produced by human hands. The artist sought to create a mosaic that looked like a painting, and this made it necessary to use very small tesserae, several millimetres in size or even less than a millimetre. This also explains the relative absence of joints between the tesserae and the painting of tesserae as well as the plaster between them (Fig. 6). In order to divide such a mosaic into sections for detachment it would be necessary to remove at least four or five rows of tesserae around the edges of each section before removal. Only in this way would it be possible to create the space needed for tools to be inserted so that each section of the mosaic could be separated from its foundation. As a result, however, the paint on the plaster in the joints would be destroyed.

No matter how much care was taken or how fastidiously the work was carried out, the relocation and necessary resetting of tesserae at the places where the sections had been divided would distort both the character of the mosaics and the images they depict. In

addition to altering the aesthetic effect, the actual subject matter of the mosaics themselves would be changed, insofar as designs with perspective require complete precision.

Furthermore, the use of precious materials in the construction of mosaics must be stressed. Tesserae made of faience, glass and onyx have been identified[4], in some cases distributed throughout the mosaics, while at other times concentrated in one spot. The loss of such irreplaceable materials during the division of the mosaic into sections would be a disaster.

4. The plaster foundation layer is of considerable importance. Hellenistic mosaics were laid on a substratum which contained a preliminary design. Furthermore, the precision and perfection in the rendering of straight and curved lines is due to the use of lead strips which were inserted into the plaster of the substratum and functioned as guides when the tesserae were laid (Fig. 7). Clearly, when detachment is chosen as a method of preserving mosaics, this foundation layer must be sacrificed, either while the mosaic is initially being removed or later, during the restoration and preservation of the sections.

The above considerations have led to further research in the following areas:

1) Possible restoration of the surviving section of the buildings and the improvement of the surrounding area by such measures as waterproofing the ground;
2) Strengthening the support and underlying layer of the floors;
3) Dealing with destructive biological elements (investigated in collaboration with trained specialists);
4) Protecting the mosaics and their buildings with permanent shelters that are not inharmonious with the environment;
5) Studying the support for a full understanding of the technology of the materials used, in order to find better methods of restoration.

DISCUSSION

Lavagne: Je remercie Madame Yiannouli de cette très belle communication qui nous a montré des pavements de Samos que peu de gens connaissent. Même Dimitris disait qu'il ne les connaissait pas. Vous avez pu voir parmi ces mosaïques, d'un raffinement extraordinaire, ce motif de postes qui se terminent par des lions à crête et qui rappellent, très évidemment, des motifs d'orfèvrerie antiques. Je pense à certains rhytons en or trouvés dans le trésor de la mer de Crimée, au bord de la Crimée, qui sont tout à fait les prototypes de ce genre de postes. Mais je ne vais pas m'engager sur les sentiers de l'histoire de l'art qui ne sont pas le propos de notre colloque.

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[4] See A.-M. Guimier-Sorbets and M.-D. Nenna, "L'emploi du verre, de la faïence et de la peinture dans les mosaïques de Délos", *Bulletin de Correspondance Hellénique* 116 (1992), pp. 607-631, fig. 1-2, pl. I-IV; and "Réflexions sur la couleur dans les mosaïques hellénistiques: Délos et Alexandrie", *Bulletin de Correspondance Hellénique* 119, 1995, pp. 529-547, pl. I-IV.

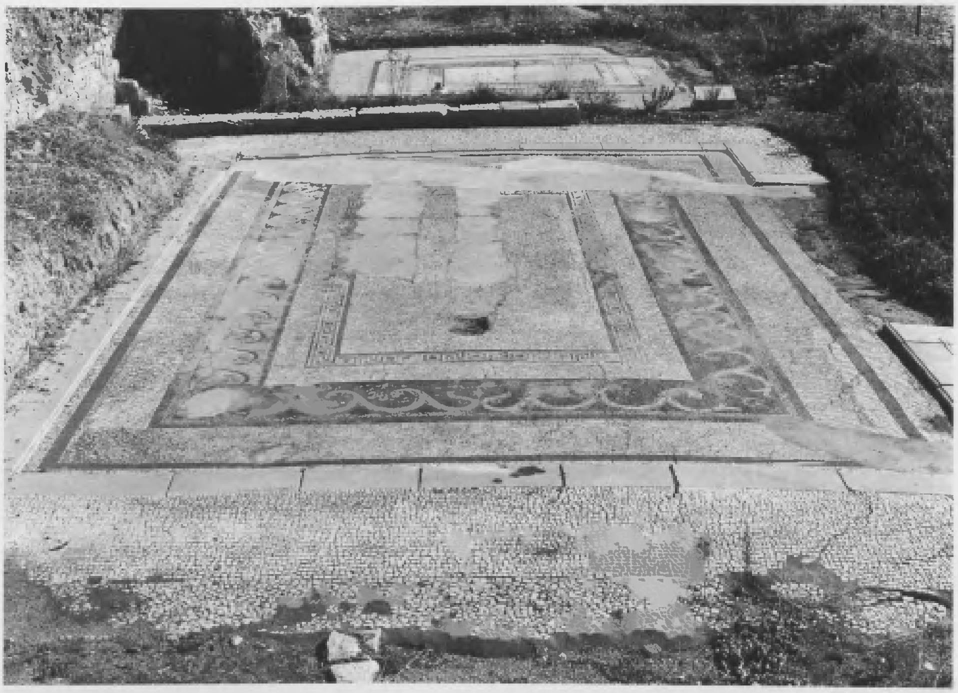


Fig. 1: Hellenistic Building. General view of the *Andron* and the eastern reception room.



Fig. 2: Early Christian basilica at *Tria Dontia*. The mosaic of the central nave.

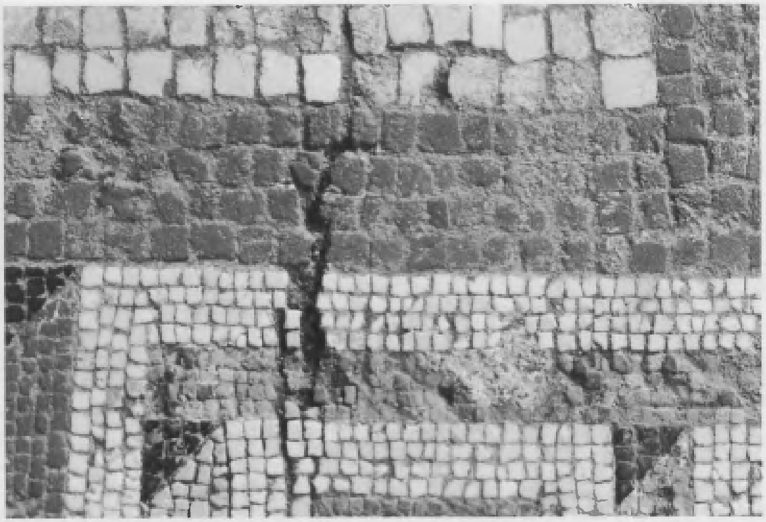


Fig. 3: *Andron* of the Hellenistic building. Detail of the band with the three-dimensional meander with a fissure.



Fig. 4: Detail of the mosaic of the central nave of the basilica at *Tria Dontia.* Crusts on the surface of the tesserae.

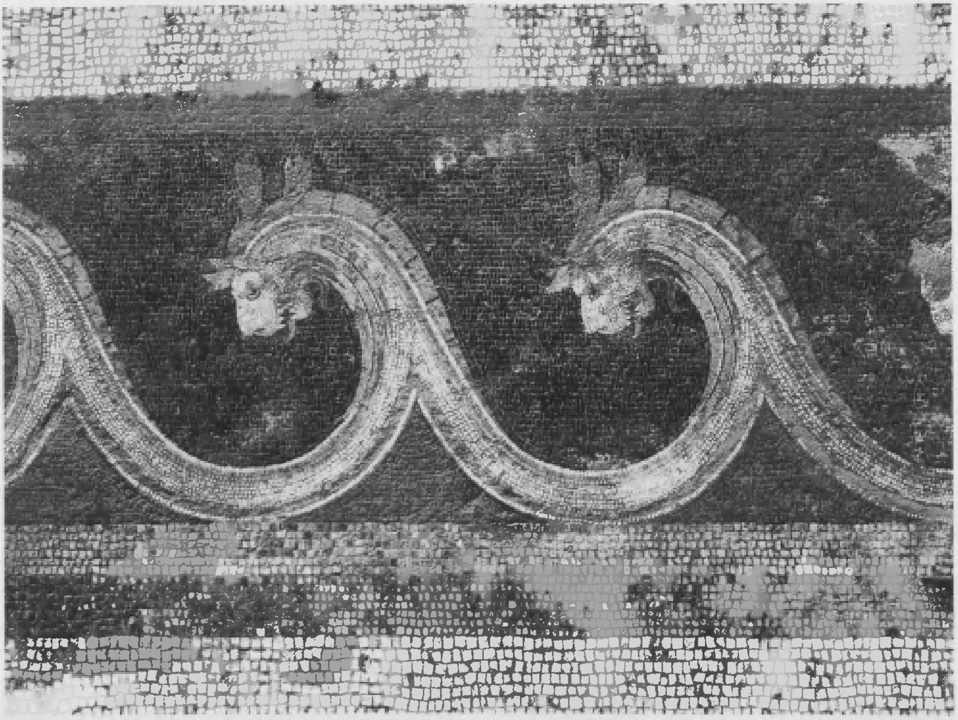


Fig. 5: Mosaic of the *Andron* of the Hellenistic building. Detail of the wave pattern band ending in griffin-lion heads.

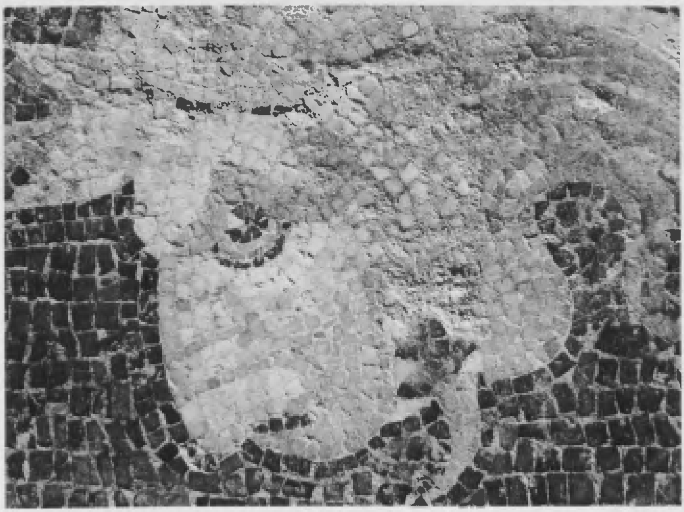


Fig. 6: Detail of a griffin-lion head.

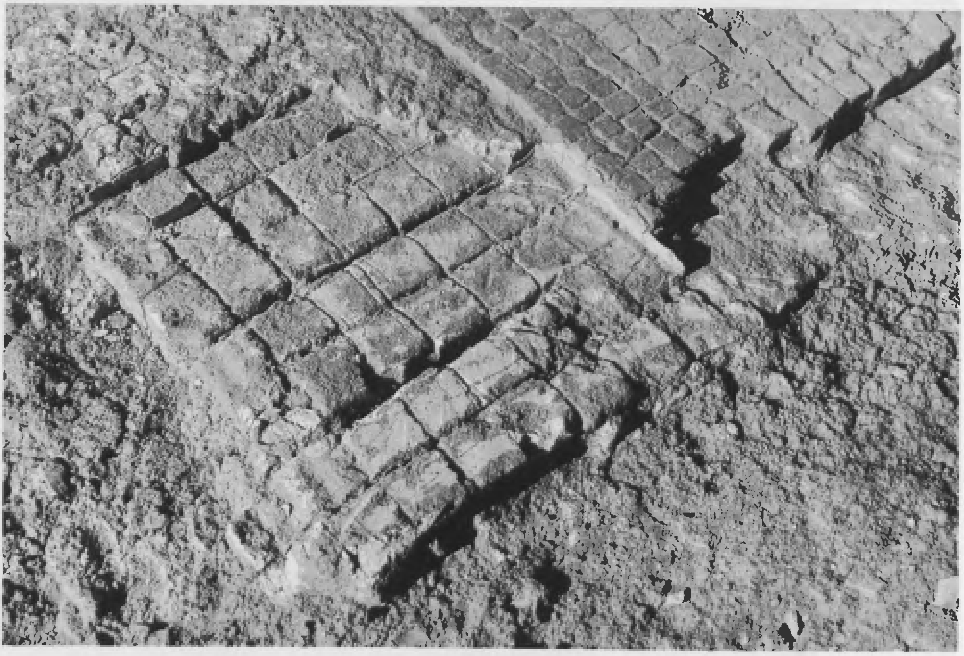


Fig. 7: The substratum of the mosaic with the griffin-lions.

Claude Bassier

Théorie et pratique de la conservation des mosaïques *in situ*

LES MOTS ET LES CHOSES

L'application des sciences et des techniques à la conservation des mosaïques est si récente qu'elle n'a pas encore trouvé un langage cohérent. Pour éviter les confusions et les erreurs, il faut avant tout s'accorder sur le sens des mots. Des termes aussi courants que mosaïque, conservation, restauration *in situ*, sont employés dans des acceptions diverses. Par exemple, mosaïque est un mot qui recouvre des techniques différentes qui ont convergé et perdu leurs dénominations premières. Le langage courant regroupe aujourd'hui, sous un seul et même vocable *opus musivum, opus tessellatum* et *opus sectile*. Il en va de même pour le mot conservation. Son sens premier signifie "maintenir en bon état", préserver de la destruction et de l'altération. Mais il peut s'agir d'un projet, d'un état, d'une condition ou même d'une administration. La mise en œuvre des techniques conservatives est censée être faite par des restaurateurs. Or, la restauration n'est qu'un cas particulier des techniques de conservation et la restitution un cas particulier de la restauration. Quant à "*in situ*", que signifie ce terme lorsque l'environnement a disparu?

Nous examinerons donc par catégories, l'usage des principaux termes qui conditionnent le projet de conservation et sa mise en œuvre. Parmi ceux qui désignent la mosaïque: les différentes sortes de revêtements, leurs caractéristiques, leurs structures et la nature des matériaux employés. Pour le tapis de tesselles: tous les termes techniques, les matériaux, la pose et le débitage. Pour les altérations: les termes qui désignent les différents processus thermodynamiques, physicochimiques, les paramètres et leurs mesure, ainsi que les différents facteurs d'altération. Pour la conservation: les termes relatifs aux principales techniques d'intervention.

DIALECTIQUE ALTÉRATION CONSERVATION

Les constructions, les monuments et leurs revêtements sont soumis depuis leur origine à des processus d'altération évolutifs. Les contraintes mécaniques, physiques, chimiques, climatiques, biologiques ou les accidents entraînent leur disparition à plus ou moins brève échéance. C'est dans ce contexte qu'il faut comprendre le terme "conserva-

tion". Il définit ici un état relatif. Il est impossible d'établir un projet d'intervention sans connaître les origines de ces désordres.

L'état le plus probable: l'altération

Prenons l'exemple de la France: l'état des mosaïques inventoriées en France au moment de leur découverte, comparé avec celui de leur état actuel, constitue un élment de réflexion préalable à toute décision de conservation. Les six premiers fascicules du *Recueil général des mosaïques de la Gaule* recensent 1326 pavements, dont 920 au sort inconnu, disparues ou détruites. Aucune des 111 mosaïques qui ont subi une intervention n'a été intégralement conservée. La superficie des mosaïques qui font l'objet du *Recueil*, représentait à la fin de l'antiquité, environ 45.000 m^2. La surface des mosaïques mises au jour est de 29.500 m^2. Seulement 3.335 m^2 ont subi des interventions. Aujourd'hui 640 m^2 sont conservés. Ceci représente 1,4 à 1,8% de la surface des mosaïques d'origine. On peut faire des constatations du même ordre dans d'autres pays, avec des différences spécifiques, en fonction de leur richesse en vestiges antiques et des moyens dont il disposent. Depuis la parution du 6° fascicule du *Recueil des mosaïques de la Gaule*, la situation a heureusement évolué dans un sens plus favorable.

PRATIQUE

Pratiques constatées

On rencontre sur les chantiers de fouilles des intervenants souvent sans moyens matériels et mal informés des techniques de conservation. Certains s'improvisent techniciens parce qu'ils ont lu des publications sur le traitement des mosaïques. Ils y voient des recettes, non une méthode. Des praticiens amateurs copient ou innovent. Certes, il n'y a pas assez de professionnels qualifiés, et les archéologues ne disposent pas toujours de moyens suffisants pour utiliser leurs services. Les administrations prennent rarement en compte l'urgence; elles choisissent surtout des solutions jugées économiques. L'analyse des publications qui rapportent des travaux effectués ces dernières années, montre que la pratique n'est pas toujours à la hauteur de la doctrine et des avances techniques. Nous en donnerons des exemples et des statistiques.

Conservation concertée et programme

Depuis quelques décennies, dans le domaine de la conservation des monuments et des œuvres d'art, la recherche fondamentale et expérimentale ont fait d'importants progrès. Bien que les mosaïques nécessitent une approche théorique et des technologies spécifiques, elles devraient en bénéficier à condition que les intervenants soient formés à la mise en œuvre de ces nouvelles techniques. Les modalités de la démarche conservative dans le domaine des mosaïques sont très variables. Nous décrivons ce qu'elles devraient être et ce qu'elles sont parfois. Tout d'abord, les conservateurs, architectes, historiens de l'art, archéologues, ingénieurs et techniciens de la conservation travaillent et réfléchissent

ensemble à la problématique complexe du devenir de la ou des mosaïques. Leur concertation a pour objet de répondre à plusieurs questions.

Quelle était la signification des mosaïques dans leur contexte d'origine? Quelle est la finalité des interventions, que conserve-t-on exactement? Pour combien de temps? Avec quels moyens financiers, matériels et humains? Dans quel but et pour quel public? Quelle est leur dévolution, quelle est leur signification, une fois traitées? Témoin de l'histoire, document scientifique, ou caution du marché culturel-spectacle? Les réponses à ces questions conditionnent le principe d'éventuelles interventions. Elles permettent de définir un programme qui tient compte de l'objectif, des moyens matériels et humains et des circonstances. Ce programme précise la séquence des opérations techniques: documentation, intervention, nonintervention, type d'intervention, suivi des travaux, surveillance, entretien.

Pratique nouvelle

La collaboration entre tous les intervenants commence dès l'origine, que ce soit une découverte fortuite, une fouille programmée, ou une opération de préservation des vestiges anciennement mis au jour. La pratique nouvelle assure une formation et une information commune aux archéologues, aux fouilleurs et aux conservateurs. Cela évite les errements anciens et favorise l'intervention d'urgence par des profesionnels. Ceux-ci sont formés aux sciences, aux techniques, à l'histoire et à l'histoire de l'art. Chacun ne fait que ce qu'il sait faire. Tous ont un langage, une méthode et un objectif commun. C'est là l'essentiel.

LES TECHNIQUES

Travaux préliminaires

Quelle que soit la solution de conservation retenue, le premier travail des techniciens consiste à bien appréhender la situation de la mosaïque dans son contexte, son histoire et son environnement physique. Une mosaïque mise au jour est un grand blessé. Sa survie est conditionnée par des mesures précises de sécurité de première urgence. Les techniciens documentent toutes les interventions. Ils procèdent ensuite aux premières phases de consolidation, puis à l'observation, l'auscultation, au nettoyage et à une documentation détaillée (relevé graphique, photographique etc.). Des sondages permettent d'établir la stratigraphie. les échantillons prélevés sont analysés. Les causes les plus immédiates d'altération ou de destruction font l'objet de mesures d'urgence: protection contre le vol, les intempéries et l'eau sous toutes ses formes. Cette première phase conditionne la suite des interventions.

Interventions

La conservation *in situ* doit être priviligiée chaque fois qu'elle est possible. Nous en définirons les conditions théoriques et pratiques. Protection permanente contre les élé-

ments, les accidents et le vol. L'efficacité et la pérennité de ces conditions sont expérimentées, contrôlées, garanties. On insistera surtout sur la stabilité des paramètres climatiques et la possibilité d'échanges d'humidité entre le sol, l'atmosphère et la mosaïque. Les caractéristiques mécaniques et physiques de l'assise font l'objet d'une attention particulière. S'il y a lieu, celle-ci est renforcée et traitée. On étudie les risques de tassements différentiels, ou de blocages de transferts d'humidité ainsi que les problèmes posés par les visiteurs, l'éclairage et l'entretien. Lorsque la mosaïque ne peut pas être conservée *in situ*, elle est déposée et transférée sur un nouveau support. Sa préservation et sa mise en valeur sont mieux assurées dans un musée où les conditions de conservation sont garanties. Nous donnerons un aperçu des principales méthodes de conservation, de leurs applications et des remarques qu'elles appellent. Des exemples montrent et illustrent dans chaque cas les différents types d'interventions ainsi que les résultats.

CONCLUSION

L'absence d'une approche scientifique et technique dans la conservation des mosaïques est la cause principale de leur altération et de leur perte. Toute démarche scientifique se fonde sur des concepts clairs et admis par tous. La préservation des mosaïques nécessite en premier lieu une collaboration étroite entre tous les intervenants de la démarche conservative pour définir le projet et le programme à retenir. La conservation *in situ* doit être privilégiée lorsque les conditions de ce mode de conservation sont assurées dans la durée. Nous décrivons les principes techniques de ce mode de conservation. Il faut être conscient que dans cette hypothèse, les bonnes conditions de conservation sont rarement réunies, que leur coût est élevé, et qu'elles demandent un suivi permanent. Ce qui précède est fondé sur des exemples concrets, une analyse typologique des cas et sur des statistiques.

SESSION 2

PLANNING FOR THE CONSERVATION OF AN *IN SITU* MOSAIC BEFORE, DURING AND AFTER EXCAVATION

Catherine Sease

Planning for conservation of an *in situ* mosaic, before, during and after an excavation

INTRODUCTION

Planning is not a new concept; everyone is familiar with it. In fact, it is so much a part of our everyday life that we do it without consciously thinking about it most of the time. We plan what we are going to wear, what we will have for dinner, or what we will do after work. Of course, for large projects and undertakings, we devote considerable conscious thought, time, and energy to planning.

Archaeological investigations are no exception. The planning phase for an excavation can involve many years of planning and preparation. First, the research goals of the overall project need to be established; what questions will the excavation attempt to answer? Once this is done, the archaeologist can then anticipate what is likely to be found in terms of architectural elements and artifacts and begin to determine a realistic time frame for the project as well as start to assemble the personnel and resources needed to accomplish it.

This is generally where the planning stops. More often than not, the next step is to start excavating. Unfortunately, most archaeologists do not include conservation in the initial planning stages of their projects. A variety of reasons are given, perhaps the most frequent one being that it was not felt to be needed. Or that it was too expensive, a frill, or an extra. Whatever the reason, conservation is all too often an afterthought. Too frequently, conservators are brought in only after problems have arisen; after a mosaic has been completely uncovered; more important, after it has sustained some degree of damage. Unfortunately, in these instances the measures that the conservator can take are limited. Conservators are not magicians and cannot reverse the deterioration of archaeological material once it has occurred. In such instances, they can only try to salvage what remains of the artifact and the information that might be contained in it. Unfortunately, this approach to conservation results in damage to the artifact, damage that while perhaps not completely preventable might have been considerably less had a conservator been involved at least at the time of excavation, or even better, prior to excavation. In addition, such salvage efforts turn out to be much more expensive in terms of time, labor, and materials for the long-term preservation of the artifact than if a conservator had been involved at the time of excavation [1].

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[1] N. Agnew and M. Wade, "A Case Study of a Palaeontological Site - The Need for Planning and Protection" in *Preventive Measures During Excavation and Site Protection*, Rome: ICCROM, 1986, p. 265.

For conservation to play an effective role in the excavation of sites in general, and mosaics in particular, it must be regarded as an integral part of the excavation process. Archaeological planning must be concerned not only with the research aspects of an excavation, but should also identify the objectives for preserving, presenting and maintaining the site after excavation. Thus, conservation planning must be regarded as a critical component of the overall process of preserving an archaeological site and all its contents both moveable and immoveable and be factored in at the initial planning stages of an excavation [2]. Not only will this assure that the budget, time and resources allocated are appropriate, it will also ensure that from the outset excavation is carried out with site preservation and perhaps presentation in mind [3]. If conservation is involved in daily excavation decisions and activities, damage to mosaics can be avoided and their deterioration kept to a minimum, and more costly salvage repairs later will be prevented.

RATIONALE FOR CONSERVATION PLANNING

The rationale for any conservation planning is to ensure the best possible long-term preservation of the mosaic with the least cultural and economic cost. It accomplishes this in several ways. First, it ensures that all conservation measures fit logically into the overall excavation plan and budget. If the work of the archaeologist and the conservator are coordinated, they do not impede, but rather complement each other. Equally important, planning enables the conservation effort to be part of the overall project budget. The treatment and long-term preservation of mosaics *in situ* is an expensive proposition. By anticipating these costs early in the planning stages, they can be included in the fund raising efforts for the entire project.

Second, planning ensures the input, if not the presence, of a conservator before, during and after the actual excavation of the mosaic. Experienced conservators have the expertise to identify the preservation needs of the mosaic at all stages of the archaeological process; they are trained to look at situations involving artifacts holistically, taking into consideration all factors involved in their preservation. Throughout an excavation, many people with a variety of different skills and expertise are associated with the project. Each comes from a different perspective and the specific needs of the mosaic are not necessarily their first consideration. Their objectives and priorities are focused elsewhere and might actually conflict with the needs of the mosaic. For example, the archaeologist is concerned with extracting the maximum information from the site and may wish to see large areas of the site uncovered and therefore oppose the backfilling of mosaics or other features. A director of antiquities or a local or ministry official on the other hand may be more interested in turning the site into a tourist attraction and therefore expect

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[2] T.C. Roby, "Site Conservation During Excavation, Petra, Jordan", *Conservation and Management of Archaeological Sites* 1(1), 1995, p. 44.

[3] J.H. Stubbs, "Protection and Presentation of Excavated Structures" in N.P. Stanley-Price, ed., *Conservation on Archaeological Excavations*, 2nd ed., Rome: ICCROM, 1995, p. 80.

buildings with mosaics *in situ* to be restored to maximize their presentation. Of all people involved in an excavation, the conservator is the one person whose sole concern is the well-being and long-term preservation of the mosaic. The responsibility of the conservator is to act as an advocate for the mosaic.

The most persuasive argument for conservation planning is to ensure the presence of a conservator on site during the actual excavation of the mosaic. This is a critical phase when all archaeological materials, not just mosaics, are most vulnerable to deterioration due to rapid changes in environmental conditions [4]. The moment of excavation can be devastating for an artifact. During burial in the ground, it slowly adapts to its surrounding environmental conditions. As it approaches equilibrium with this environment, deterioration is slowed or possibly even stopped altogether. Upon excavation, the artifact is suddenly exposed to abrupt changes in ambient temperature, relative humidity, light, and oxygen. These changes can bring about rapid responses in archaeological materials as they try to adapt to the new ambient conditions. When excavating, it is important to take all possible measures to minimize the stress these changes may put on the artifacts. The conservator has the expertise and skills to do this and should be on hand at the moment of excavation to intervene if necessary to ensure the well-being of the artifact.

In addition, excavations can present many surprises. Mosaics may not be expected, but must be dealt with when found unexpectedly. A conservator on site can be extremely useful at such times. Even if the archaeologist and the conservator together have decided during initial planning that the conservator's presence is not required on site full-time or in the initial seasons, having a conservator on call who is familiar with the project and has ideally visited the site will greatly help if and when conservation problems arise unexpectedly.

Third, planning ensures that all conservation work is done in a logical progression. Conservation is not a single activity, but rather a series of activities and careful planning is necessary to ensure that they are not done piecemeal, but form part of a comprehensive plan. In any conservation treatment, one step follows and builds on the ones preceding it. If procedures are undertaken out of sequence, their effects can be negated later so that they must be repeated, or they may need to be reversed before the next step can take place. Both can result in damage to the mosaic. For example, detailed *in situ* cleaning and repairs could prove to be a wasted effort if the mosaic must subsequently be lifted.

Long-term protective measures taken must also fit in with the overall conservation effort. The effects of the best hands-on treatment will not last long if it is not followed up with appropriate preventive care. In the case of mosaics, good treatment will rapidly be undone if the mosaic is left exposed and unprotected, and good maintenance is not undertaken regularly.

An important outcome of the necessary interaction between the conservator and the archaeologist that takes place during the planning of an excavation will be the establishment of good rapport between the two. By understanding each other's aims, they can

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[4] G. de Guichen, "Object Interred, Object Disinterred" in N.P. Stanley-Price, ed., *Conservation on Archaeological Excavations*, 2nd ed., Rome: ICCROM, 1995, pp. 21-28.

establish a trust that is vital to a good working relationship. Once excavation is underway, trust and cooperation are crucial as the discovery and subsequent excavation of mosaics can cause conflicts of priorities unless the conservator and the archaeologist understand and appreciate each other's concerns[5]. For example, excavating a mosaic too rapidly can result in partial or even complete loss of context vital to the archaeologist. On the other hand, being exposed too long without treatment can have serious and irreparable consequences for the well-being of the mosaic.

THE PLANNING PROCESS

It is important to recognize that when dealing with the conservation of mosaics, all architectural elements in fact, planning needs to go beyond the immediate needs of the mosaic. It should involve the whole site, or at the very least take the whole site into consideration. The mosaic's treatment must be seen as being part of the larger effort. For example, trenching, while necessary for the treatment of the mosaic, may well destroy stratigraphy or features. Similarly, the long-term post-excavation plans for the site may affect the choice of treatment of the mosaic as well as dictate the measures needed for the appropriate post-excavation care of the mosaics.

Planning entails determining in as much detail as possible what conservation work is needed and at what stage of the excavation it must take place: before, during or after.

INITIAL PLANNING

As much planning as possible should take place before excavation starts. Before any planning can take place, the conservator must become familiar with the site. There are two components to gaining familiarity with the site, one intellectual, the other practical.

Intellectually, as mentioned above, the conservator needs to understand the research goals of the archaeologist and see how they will be accomplished through excavation. He must envision the conservation work as being part of the larger effort and comprehend how it fits into the whole.

On a more practical level the conservator needs to understand the physical aspects of the site. The better an understanding the conservator has of the prevailing site conditions (its location, proximity to a town, sources of water) and burial environment (yearly variations in temperature and relative humidity, frost, soil pH, wind), the better he can predict the state of preservation of the mosaics. Armed with this information, he can be well prepared to put together an effective treatment plan. This also generally allows for smoother operations and a faster working pace once excavation and conservation work actually start.

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[5] N.P. Stanley-Price, "Excavation and Conservation" in N.P. Stanley-Price, ed., *Conservation on Archaeological Excavations*, 2nd ed., Rome: ICCROM, 1995, p. 4.

The best way for a conservator to become familiar with the site is to actually visit it. Far from being a luxury, a pre-treatment visit can be an extremely valuable step in the conservator's gaining familiarity with the site and its mosaics. Such a visit does not necessarily have to be long, provided the conservator is able to get enough information to feel comfortably knowledgeable about site conditions and the state of the mosaics in question.

During a site visit, the conservator can accomplish several important things. First, he can see the site conditions for himself. Nothing can take the place of seeing with one's own eyes what the actual situation is. The conservator does not need to rely on the assessment of others who will not necessarily see the site conditions in quite the same way as a conservator does. By observing how already excavated elements are weathering, the conservator can better anticipate how various treatment options might last and, in turn, decide on a treatment suitable not only for the needs of the mosaic, but appropriate to the site conditions as well.

A conservator can also examine the mosaic if it has already been excavated, noting its condition and treatment needs. Detailed plans and drawings of the mosaic can be made at this time as well as photographs taken to document its condition. The same can be done for adjacent areas of the site that might be relevant to the mosaic's treatment.

If the conservator visits the site while excavation is underway, he can observe the excavation process and gain an insight into how the archaeologist works at that particular site. By so doing, sometimes the conservator can anticipate problems that might have an adverse impact on the treatment or well-being of the mosaic. The archaeologist has many things to consider during an excavation season and at times may lose sight of the mosaic's preservation needs. The conservator can point out problems and suggest changes in excavation strategies that might help eliminate some of these problems.

A site visit also enables the conservator to take samples, for example, of mortars, so that testing can be done on them prior to treatment which could affect treatment options. In addition, the conservator can find out first hand what conservation supplies and materials are available locally. If there are any questions about the suitability of various materials, samples can be collected for testing.

Once familiar with the site and the conservation problems likely to be encountered, the conservator can begin to develop a treatment plan and budget. First, he needs to determine in consultation with the archaeologist the degree of conservation work to be undertaken. Will the goal of conservation be just to stabilize the mosaic, or will display or presentation standards be required? The difference between the two in terms of time, effort and expense will be enormous. Clearly, the degree chosen will be affected by the long-term plans for the site.

Once the level of conservation is determined, the various stages of the conservation work can be identified. Time estimates can be calculated for each stage and realistic schedules worked out. The conservator can then determine the work force and materials needed to accomplish the conservation work and begin to assemble them. If more than one conservator is needed or different conservation skills are necessary, the appropriate people can be identified and their services secured. As well, the skills and expertise of other

consultants may be identified, such as an architect for designing appropriate protective structures for the mosaic once excavated.

Organizing and eventually purchasing the materials and equipment needed for the treatment of the mosaics is another important part of the planning process. In identifying what materials might be needed, the conservator must take into consideration all eventualities that might arise. If treatment does not go according to plan, for example, it will be necessary to change plans in mid-stream. Such changes may require totally different supplies and equipment that are not readily procurable on-site. A good conservator tries to be prepared for such situations.

Organizing supplies is especially important if the site is in another country. The conservator needs to determine which materials and supplies can be obtained locally and which need to be imported. Knowing what is available locally is particularly valuable in the case of flammable, oxidizing materials that are not easily transported. Although such materials can be air-freighted, their clearance through customs can be difficult and take up valuable work time and funds. If they are sent overland, their transport must comply with the laws governing the carriage of such materials in the countries involved.

While this would seem to argue in favor of relying on locally obtained materials, they can present their own particular problems. For example, alcohol, frequently used as a solvent in on-site conservation, often contains additives in the form of dyes, perfumes, and chemicals such as pyridine. While dyes can usually be removed easily, the removal of other additives is more difficult, especially if you do not know what they are or indeed that they are even present[6]. In addition, the local source of materials and supplies needs to be steady and reliable. It can be frustrating for the conservator and potentially damaging to the mosaic to start using one material only to find that it is not available a week or two later, or if available, is not of the same quality.

As planning proceeds, a realistic budget for the conservation work begins to emerge. The cost of on-site conservation in general can be expensive in terms of labor, materials and equipment. If mosaics are involved, the costs can go up astronomically. Because they are usually big and awkward, their treatment requires a significant outlay of funds. Many factors will have an impact on the conservation budget, including degree of conservation undertaken and long-term plans for the site. It is important for these issues to be carefully identified so that the conservation budget is appropriate, accurate and realistic.

DURING EXCAVATION

While as much planning as possible is done before excavation starts, some inevitably can only take place as excavation proceeds. Together with the archaeologist, the conservator needs to keep an eye on the excavation process and be prepared to re-assess excava-

[6] K.W. Tubb, "Preparation for Field Conservation in the Near East", *The Conservator* 9, 1985, p. 18.

tion strategies at all times. While the conservator may not be involved in the actual excavation of the mosaic, he may need to intervene with treatment as excavation progresses. If a mosaic is encountered unexpectedly, an experienced conservator is in the best position to assess how excavation might affect its long-term preservation and develop strategies for its protection. For example, it may be in the best interest of the mosaic to suspend its excavation or that of the surrounding areas as a protective measure until the rest of the excavation is finished, using the overburden of dirt as a protective layer. If the mosaic is already partially exposed, it may be necessary to backfill it as protection from continued excavation activities. Or it might be necessary to apply facings to protect fragile areas so that excavation can continue, or to consolidate disturbed areas of tesserae so they can be lifted and removed from the excavation altogether.

Throughout conservation treatment, the conservator constantly assesses and anticipates the needs of the mosaic and adapts the original treatment plan as necessary. As this work proceeds, the conservator can begin to determine what measures are needed to protect the mosaic from one season to the next. The sooner this is done, the sooner the materials needed for the job can be assembled so that the work can proceed in a timely fashion and not be a frantic last minute effort.

BACK-UP STRATEGIES

An important component of conservation planning is having back-up strategies. Anyone who has worked on an excavation will realize that so far only the ideal situation has been discussed and unfortunately these conditions rarely seem to occur. In spite of careful planning, it is likely that the conservator will have to modify his plan in one way or another as work proceeds. Unexpected conservation problems present themselves with alarming regularity once work is underway. In such instances, the conservator is faced with difficult decisions that need to be made on the spot. Having an initial plan in place can make these emergency decisions considerably easier. An experienced conservator who has a good plan in place before starting treatment is most likely also to have considered suitable back-up strategies for just such situations. Without some prior thought and anticipation, conservation emergencies can lead to disaster.

When things go awry, the conservator must be prepared to withstand pressure to act precipitously until the best approach to handling the problem has been determined. Any emergency planning must be done in close cooperation with the archaeologist for several reasons. Discussions of the various options available not only help to reach a workable solution, but can also serve to reassure all concerned that the problem is undergoing serious consideration. It can also help them to understand the need for delay while alternate strategies are devised[7].

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[7] *Ibidem*, p. 19.

POST-EXCAVATION TREATMENT

The best planning can only go so far in determining the long-term post-excavation needs of mosaics as it is unknown at the outset exactly what will be found. Once excavation is finished, however, the conservator knows the full extent and needs of the mosaics and can adjust or augment the initial plan for their long-term management. Clearly, overall plans for what happens to the site after excavation will be a major factor in these revisions. If there is little potential for turning the site into a tourist attraction, it may not be feasible or appropriate to keep the mosaic exposed and the best course of action may be to rebury it.

Reburial is not a simple procedure, especially if the mosaic has been uncovered for an extended period of time. It can be as stressful to the mosaic as excavation was as it changes the environment yet again, resulting in additional damage to the mosaic. To minimize the effects of reburial on the mosaic, planning, materials and the expertise of a conservator are required.

Alternatively, the site might lend itself to being turned into an archaeological park or tourist attraction. In this instance, the necessity of leaving the mosaic exposed is obvious. To do this, however, involves foresight and planning.

First, it is necessary to determine how best to protect the mosaic. Will a simple roof or shelter suffice or will a more solid structure be necessary? Will the condition of the mosaic allow any of these options? Once these questions are answered, the input of specialists may be called for, such as architects or structural engineers to help plan, design and oversee the construction of a suitable protective structure. Just as the archaeologist must be involved in these deliberations to ensure that the shelter is in keeping with the site and does not damage it from an archaeological perspective, so should the conservator be involved to ensure that the mosaic will not be physically damaged and that the structure will function as planned to meet its needs.

MAINTENANCE

Once the appropriate protection is in place, the question of maintenance of the mosaic must be addressed. All too often, the end of excavation means the abandonment of the site, leaving it to the ravages of the environment: humans, livestock and plants as well as the weather. Regular maintenance is a key activity in preserving a mosaic or any other architectural element; without it there is little hope of preserving them. Balderrama and Chiari [8] have pointed out that in many instances a good, careful maintenance program

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[8] A.A. Balderrama and G. Chiari, "Protection and Conservation of Excavated Structures of Mudbrick" in N.P. Stanley-Price, ed., *Conservation on Archaeological Excavations*, 2nd ed., Rome: ICCROM, 1995, p. 106.

can give better results in the long run than the most sophisticated, expensive treatment. Without question, good maintenance is invariably cheaper than emergency fix-ups[9].

A plan is needed to ensure that maintenance work gets done. Not only must the plan determine what actually needs to be done to maintain the mosaic, for example routine cleaning, checking the mortar, weeding, and monitoring, it must also clearly spell out how often the various activities should take place and who should do them. To be effective, any plan needs to be realistic and workable. Without attainable goals and an appropriate, dedicated work force, the best maintenance plan is merely a piece of paper.

The effectiveness of the maintenance plan also hinges on the cooperation of the local, regional, and possibly national authorities. Generally, the archaeologist's responsibility ends with the excavation, certainly with its final publication, when local or national authorities assume control of the site. Therefore, it is important for any maintenance plan to be worked out with the appropriate agency.

Then there is the question of who will undertake the maintenance work. Can local people be trained to do it, or will it require more expertise, such as that of a conservator? If the former, is there an appropriate cadre of people who are dedicated enough to continue maintenance work regularly over the long-term? Some site managers have found it expedient to rely on local people, such as custodians, to do the routine monitoring under the supervision or regular input of a conservator. In theory, it is best for the conservator to have a continuing involvement with the site, but this is not always practical, especially if the conservator is not based in the country where the mosaics are located. The abilities of local people are often underestimated, but they can prove to be valuable and reliable workers. Having them monitor conditions can serve to invest them with a sense of responsibility and give special meaning to their job. As a result, they are more likely to regard the site as their own and become protective of it, willing to expend extraordinary amounts of time and effort towards the preservation of the mosaics. And as they are around all year, they often have a better understanding than anyone of what is actually happening and can provide the conservator with extremely accurate observations.

CONCLUSION

Even though every site is different and presents its own set of circumstances, the basic principles of planning hold true for all archaeological conservation. Conservation planning is vital for the long-term preservation of mosaics and should be an integral part of the archaeological planning process. Simple conservation problems are magnified by the size and weight of mosaics, and are complicated by the fact that they form part of a larger architectural whole. Thus, the conservation of mosaics involves a larger effort, requiring more to be in place before work can begin.

It is crucial that sufficient time be allocated for conservation planning even if it means delaying the start of work so as to ensure an appropriate treatment plan with suf-

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[9] Agnew and Wade, *op. cit.*, p. 264.

ficient personnel, materials and funds to provide optimum working conditions. If all these are in place, the rest will generally follow and result in the best possible long-term preservation of the mosaic.

DISCUSSION

Ben Abed: Once again you have come to us and come to the archaeologists to convey a message, and the message is that the situation has, indeed, changed. You did mention an ideal situation and kept on repeating that a conservator is a sort of physician on the site and that these sites require the presence of physicians. For the purpose of excavation you also said that the conservators are virtually more important than archaeologists. You also mentioned the funding problem and the necessity to provide for the attendance of conservators. All this is very important indeed and is very commonly argued these days. This is a fairly ideal picture, and I have the feeling that you are operating in a sort of environment which is slightly different from the one I am operating in. And given that I am absolutely convinced about your arguments, if I wished to handle the preservation of the site, the problem that would come to my mind and that I would raise with my archaeologist colleagues, is the following: is it still possible to go on excavating today? Should we not rather start from scratch and rethink our approach to excavations? And I intend to take such a stand because I come from a totally different country; I mean, the subsidies are granted by the state, and it is not possible for me to call upon the services of a conservator because you all know that the fees of conservators are much too high for me to afford. And before making the decision to start an excavation, I will take some time to think. I might decide to call upon a foreign mission, but not any foreign mission, because some have the resources to consult with architects, engineers and others to set up a proper conservation plan. Some other missions, unfortunately, are virtually as deprived of means as I am, although their scientific value is, hopefully, much greater than I can attain in my country. So, this is a problem which is more and more frequently raised, and I am personally very happy to be addressing an audience mainly composed of conservators. As a matter of fact, I have the feeling that we are all talking about things that we ignore in reality. We do not interact enough, we do not talk to each other enough because there might be some fears on the part of archaeologists with regard to conservators, and this might be the day for us to open this dialogue and for you to tell us whether there are still opportunities to continue excavating or, on the contrary, whether we should decide to stop excavating.

Chiotis: I am a professor of conservation in Athens and a painter. We have not yet heard the voice of the conservators. We are hearing about conservation *in situ.* Of course, everything is very interesting and very good theoretically, but what about technically — the technical aspects which concern us as conservators? There is no clarification as to what we mean by *in situ* conservation, partial or total. What are the technical difficulties which a conservator will know about? An archaeologist, from

a certain point onwards, must be led by the conservator. But archaeologists persist in standing aside from us and not working with us on *in situ* conservation. To what extent can the conservator work freely *in situ*, and to what extent is this determined by the archaeologist? I would also like to say that there are technical problems. We are talking about *in situ* conservation. A mosaic can, with simple consolidation, remain *in situ*. When half of it is destroyed and the other half is in good condition, what happens then? Do we undertake partial detachment, take it to the workshop and bring it back and say that it has been done *in situ*, or is it detachment, lifting? And the bedding is often in very bad condition. These are cases about which we have not actually heard so far, but I hope that these comments will give rise to further discussion.

Ben Abed: Si vous voulez, ça serait quandmême bien de rester un peu de poser des problèmes fondamentaux et rester au niveau de ce plan et au niveau de ces choix.

Bakirtzis: I do not believe that I can answer the question which you have actually posed, Mme. Chairman. Continuation of excavations is something that cannot take place unless the sponsors and funders, at least in our country, in other words, the political leaders, want excavations. But I can comment on your question and say that, for example, Amphipolis is an important Roman and early Christian town with many Early Christian mosaic floors. When the subject was raised whether to continue excavations or conserve the mosaic floors, the Archaeological Service in Greece and the Archaeological Society of Athens, which is the competent authority for the continuation of the excavations in Amphipolis, decided to slow down and almost to stop the excavations and to give priority to the preservation and conservation of the mosaics.

Sease: I think there are good arguments for stopping excavation. I think the ethical approach is that if we cannot take care of what we are excavating, we need to slow down so that we can take care of what has already been excavated.

De la Torre: Rather than asking whether we should stop excavating or not, we might ask whether conservation is not an integral part of excavation. In the same way that we would not conceive of an excavation today in which documentation of the excavation is not kept or that publication does not happen later, what we should be aiming for is that conservation, and taking care of what is found, is also part of the archaeological process. I do not think we should polarize it to the point of talking about the archaeologist against the conservator. They are a team, and conservation is part of the archaeological process.

Ben Abed: Thank you for giving us some hope, Marta.

Solar: Aïcha (Ben Abed), you were talking about an unfortunate situation in your own country; but I think what we should be aiming for is, let us say not an ideal situa-

tion, but at least a better situation. I am not talking about the present unfortunate situation in which the archaeologists rule the sites, they own the sites, they do whatever they want and they call in the conservator. In a better situation there would be cooperation between archaeologists and conservators. But even this will only be one step ahead and that is not enough. An archaeological site is part of an environment; a mosaic is part of an archaeological context. The values are different for different audiences, for the archaeologists, the visitors, those interested in the economy of the country, tourism and so on. The planning process is, therefore, a much wider process that has to encompass most if not all aspects. This means that the professionals involved should not be different professionals called in at different moments in the life of a project. They should be there at the design of the project and have their input when it starts. That of course is an ideal situation, but that is what we should be aiming for, and we can compromise when necessary.

Anastassiades: [trans.]: It is ridiculous to talk about who gives orders on a site, who is the person in command. The situation is governed neither by the archaeologist nor the conservator but by the archaeological discoveries themselves.

Corfield: If I could comment, Mme. Chairman, on your objective of limiting excavation, this is certainly something that we have had to face up to in England, not only because of the cost of excavation but particularly because of the cost of dealing with the materials after the excavation. This can be far more expensive than the excavation itself, certainly in the case of mosaics, where one has to have a longterm programme for their care extending well into the future. So, our objective is to avoid excavation wherever possible, and, indeed, where sites are likely to be affected by development, which is our main threat, not the threat of the minister of tourism, we try to arrange the development so that it does not affect the archaeological site or only minimally affects it. This is our first objective. It is not always possible to avoid excavation, so we have established a planning strategy for archaeology, which follows very much Catherine Sease's objectives, I think. We call this the management of archaeological projects, or as we use a shorthand, MAP; this provides us with a framework which starts with the planning of the excavation, and that has to be approved. The first stage, then, will be an evaluation of the site to determine what is likely to be encountered if a full excavation goes ahead. And I think that far too many excavations begin without this preliminary evaluation, some small holes just to see what lies beneath the surface, because even with the best technology and the best information, we cannot know until we see. After the evaluation, again, an assessment of what we have found and a decision about whether we will go ahead with a full excavation. If we go ahead with a full excavation, at all stages we expect the excavation to be carried out by a team, a team of people who will, yes, always be headed by an archaeologist as a director. But this is usually an archaeologist with the best expertise to deal with that site. So, again, if mosaics are likely to be encountered, someone who has had previous experience of that. But also, with all of the supporting skills where they are needed, particularly the conservators. Often in

England not actually on the site all the time, although occasionally, but available at very short notice to go out. And always identified within the plan. And then, again, at the end of the excavation, another assessment is made to decide what we do with all this information that we have discovered, and if during the excavation we find something unexpected, again, another assessment to decide how we change the plan to meet that need. So, it is at every stage we are carrying out a continual assessment of what we are discovering, and a continuing assessment of what the need will be into the future. But in all this, I think increasingly, although not always, I am afraid I have to say, conservators and archaeologists and all the other specialists who are involved in the site are working as an equal team of specialists to bring the greatest benefit to the outcome of the excavation. And I think this is the only way that archaeology can work, firstly by only excavating where we have to excavate, and secondly, by making sure that when the excavation takes place, a proper plan is drawn up which incorporates all the people who are going to be needed to ensure that the information that comes from the site can be dealt with properly.

Sease: I couldn't agree with you more. I really feel that archaeological excavation is a team effort. The conservator is one person, one member of the team; the archaeologist is another member of the team, and we should work together for the common good of the site and the material that is being excavated.

Roby: One question and a comment. One of the frequent reasons given for why conservation does not happen during excavation is because it is difficult or impossible to find funding for conservation until you have found something. I would like to hear a comment either from you or anybody here who knows of examples to the contrary. With regard to teamwork I think it is very important for the conservator to be involved in fundraising because I think the conservator is more likely to know the possible sources to go to. But my experience is that fundraising is not considered to be an activity of the conservator.

Sease: In response to your second comment concerning fundraising, in a few instances as conservator I have been asked by directors of excavations for whom I have been working for possible sources of funding, specifically for the conservation effort. So, some archaeologists do involve the conservator in at least thinking and strategizing in the fundraising aspects of excavation work. Granted, it is a limited number, at least in my experience, but there are some who do. With regard to getting money before you excavate, obviously, I was talking about the ideal situation where you can have everything in place ahead of time. Clearly, it does not always work that way, and in many instances, as you rightly point out, it is only when you start excavating and you find a mosaic or a wall painting or whatever that you suddenly realize that you need a larger conservation effort. And I do not know of many specific examples of where this can and has been anticipated ahead of time. But then you need to start thinking immediately in terms of the well-being of the mosaic, let us say, and be prepared to stop excavation in order to get the appropriate expertise, fund-

ing, materials, and so forth lined up so that you can proceed with the excavation of the mosaic.

Bakirtzis: [trans.] After the comment by Mrs. Vaccaro about the publication of excavations, I would like to inform you that at the University of Thessaloniki, classes are given in methods of excavation and conservation, not in the university but in the storehouses and the museum storerooms where the unpublished finds of older excavations are housed. I believe that the next generation of archaeologists will publish and conserve older finds. This programme has the advantage of not costing very much, and it does not entail the problems of excavation and conservation of *new* finds. I hope other universities will begin such classes.

Ben Abed: I would like to make two comments from the chair. Firstly I would like to say that I am very interested and very happy for my colleague from Great Britain for the manner in which he has described the excavation process. I would like to put a question to the floor. I would like to know whether in countries such as Greece, Cyprus or the Lebanon this sort of process is already being used. It is obviously ideal for there to be a general policy, and a holistic approach including initial planning before digging begins. I would like to know what is happening in countries other than England, which is obviously the spearhead of progress in this field, whether there is a planning process? And Israel, too. Secondly I have a question for the speaker. She did not fully take account of something that is very important, which is what I would call emergency digging, fortuitous discovery. This is something that happens almost daily in some of our countries where the archaeologist has a few days or a few months to deal with an emergency, a catastrophic situation. How should you plan in such cases? Should there be a standard plan for that sort of case, or should we deal on a case by case basis? I hope that we will have a discussion on that, and that there will be a lot of answers.

Michaelides: in relation to your first point — and I think it is related to all that we have been discussing — we are discussing an ideal situation, and that is what we all want. But we have to start from the beginning. In many countries, including my own, it is pointless to discuss whether it is the archaeologist or the conservator that is more important or is running the site; neither of us decides. First of all, we have to raise the level of the conservator in the eyes of those people that provide the money. By tradition, in some parts of the world, conservators have been considered as technicians. Although their status is changing, in the eyes of the authorities that give the money they have still not achieved a higher level of recognition. So, automatically, the archaeologist feels that he is superior or takes better decisions than the conservator. Thus it is not a matter of a quarrel between us, but rather the difference in the standing of our two professions in the eyes of people higher up.

Stanley-Price: Following the comment by Dimitri (Michaelides), I agree that in the end, if things are going to change, they depend very much on decisions by those in po-

sitions of power in ministries of culture, in archaeological services, in the authorities of the country. I think although progress has already been made in the general field of archaeological conservation, if we think that our speaker, Catherine Sease, has been encouraging the integration of conservation with excavation for at least fifteen years — writing about it and making a very good case for it — and the fact that our chairman, as an archaeologist, is talking strongly about whether we should stop excavating, I think that is a good sign and is not unique to this particular case of a change of approach. To go back to the first point and to take up a comment made by Professor Bakirtzis in his first intervention, there is often political pressure to excavate, and your decision is made automatically; one must excavate. I think it is difficult to envisage but it is important to try and bring about a change of attitude at that level and to try and change the atmosphere of thought within the country with regard to excavation and the responsibilities that go with it. Just to give one example, I would like to mention the case of Portugal, where about three years ago some very important rock engravings were about to be destroyed by flooding, and thanks to a campaign by the public with demonstrations in Parliament, outside Parliament, and publicity in the press, they were saved and they are now open as an archaeological park and being visited in very large numbers by the public. The whole atmosphere has changed within the country with regard to archaeology and the conservation ethic. And I think I could risk saying that if any archaeologist in Portugal now was to undertake a project without taking conservation into account, they might find themselves if not out of a job, at least having a lot to explain. But there is a complete shift in popular opinion, and I think that is the sort of thing we have to try to aim for in our countries.

Nikolaïdou: The last comment by the chairperson dealt with the problem of rescue excavations, a very important problem that we have in Greece. Where I work in Thessaloniki, which is a modern city built on top of the ancient Hellenistic city, we no longer have the dilemma of whether to stop excavations. Excavations are compulsory every day. So, what can we do? This is what we have been thinking about, and this is what concerns us. We need small, flexible projects, joint archaeological and conservation projects; we do not distinguish between these. It is one service. And I think that the answer is that the service must be very, very well organized so that it can act, it can intervene immediately in a rescue operation. It cannot only be designed to deal with the conservation of mosaic floors; we have frescoes, we have sculptures and other things which need immediate conservation. We do not have time to think or to postpone the beginning of an excavation because excavations are usually on a private plot of land which will be built on very soon. So, we are not usually talking about preservation or conservation *in situ*.

Corfield: Many of the great cities of the world are built on ancient sites, and cities great and small are being developed at an increasingly rapid pace. And in many countries in the world now, the principal that the polluter has to pay for the damage he causes applies. The idea that the developer of a site should have to pay towards the cost of the rescue of the material that he is necessarily going to damage or destroy is, I

think, a sound one; it is certainly one that we apply in England, to great effect. To give an example, English Heritage, the national body for archaeology, has a budget of some five million pounds a year for archaeology. Unfortunately, getting less and less every year. The money that developers are paying to carry out archaeological excavations on the sites that they are affecting we estimate amounts to some one hundred million pounds a year. And the difference is very significant. But it is a price that developers in England, and in the United Kingdom in general, have agreed to accept as one of those essential costs that have to be borne by the development activities. They are going to make a lot of money out of developing the site; it is simply another factor to be taken into account when they work out their costs. I would like to say that it works well; it does not work as well as I would like it to work, as a conservator, because too often the conservation end of the project is not given sufficient weight. But I think we are improving, and I hope that it is a process that can commend itself to others.

Palumbo: With regard to the comments of Mr. Corfield, I would like to say that a similar situation is also occurring in Jordan where the country's excavation unit of the Department of Antiquities is taking great care in trying to work together with Public Works and other ministries concerned with development in the country in order to minimize damage to archaeological sites. The way Public Works is reacting to this is encouraging because they are also providing financial help and minimizing the cost of archaeological intervention. Thus, the situation that has been described by Mr. Corfield is something that can also be applied to developing countries to great effect for the minimizing of damage to archaeological sites.

Sease: In response to your question a few minutes ago about planning for rescue conservation, clearly, it is difficult to plan for. If you do not know what you are going to find, if you are excavating and you suddenly uncover something that requires a major conservation effort, I think this is where cooperation and teamwork come into play. If we work together, if we communicate, if we get to understand the concerns and learn to trust the others, then we are in a better position to respond immediately when problems do arise. As was just mentioned, in the situation in Thessaloniki, I think that is what we should be striving for — a cooperative effort so that we can respond quickly to emergencies when they do arise.

Ben Abed: With your permission, I think we had better close the discussion on the keynote speech. We all agree on the need for cooperation; henceforth, excavation must be planned in advance, and it can only be planned with a view toward conservation and preservation, and this involves political decisions at the highest level. We must therefore try to "sensitize" the powers that be and the authorities to work out a planning policy of a suitable type, integrating all the aspects that we have covered, and I am convinced that in a certain number of countries the process is well under way. We can now express the hope that the process will continue and become more widespread and that it will finally affect everyone, gradually reaching all our countries.

Arghyris Bakirtzis, Charalambos Bakirtzis, Pandelis Xydas et Michalis Kamilis

Protection du pavement en mosaïque de la “Basilique de Paul” à Philippes

A l’est de l’Agora de Philippes s’étend un grand ensemble paléochrétien des 5e et 6e siècles comprenant une église de type octogonal avec baptistère, annexes à vocation cultuelle, bains, un évêché et une auberge pour les pélerins. Avant son établissement, l’endroit était occupé par un sanctuaire des temps hellénistiques tardifs avec un tombeau de type macédonien, dont la superstructure avait la forme d’un temple antique. Les fouilles dirigées alors par Styl. Pélékanidis avaient mis à jour au même endroit une bâtisse très intéressante datant d’avant la création de l’ensemble de l’Octogone. A l’intérieur de l’enclos du sanctuaire et en contact avec le côté du sud de l’édifice tombal fut construit, après l’édit de Milan sur la liberté de culte en 313, un prieuré chrétien, qui se trouve être le premier établissement chrétien à Philippes [1].

Le prieuré avait un pavement en mosaïque portant dans des compartiments carrés des représentations chrétiennes symboliques, des tracés géométriques et une inscription d’où il ressort qu’il fut édifié durant l’épiscopat de Porphyrios, dont on sait qu’il participa au concile de Serdica en 342/3 ou 343/4.

La trouvaille a d’autant plus d’importance que le prieuré est dédié à Saint Paul et que le tombeau hellénistique a été incorporé aux bâtiments annexes de l’Octogone et transformé en lieu de culte d’un martyr chrétien, probablement l’apôtre Paul lui-même. Par conséquent, l’importance de la découverte, qui constitue la preuve archéologique du passage du monde profane au monde chrétien, imposait le maintien de la mosaïque en place, et, après sa restauration, son accessibilitè directe au public.

Le pavement en mosaïque du prieuré de Philippes a été découvert en deux périodes, en 1962 et 1963, et les travaux de sa consolidation ont commencé aussitot après. Il a été déposé par plaques et reposé sur un nouveau substrat de 25-35 cm d’épaisseur, fait de pierres et de briques concassées pour empêcher la remontée de l’humidité du sol, recouvert de deux couches constituées de poudre de brique, de ciment artificiel, de sable de carrière, de chaux vive et de pierre ponce (en proportion $^{3}/_{4}$ - 1 - 1 - 3 - 2). La seconde couche, d’une épaisseur de 7 cm, constituée des mêmes éléments, mais tamisés, a reçu le lit de tesselles (Fig. 1).

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[1] V. récemment Ch. Bakirtzis et H. Koester (eds), *Philippi at the Time of Paul and after his Death*, Harrisburg, Pennsylvania 1998.

La mosaïque fortement exposée aux intempéries restait couverte pendant l'hiver d'un film plastique et de sable qu'on enlevait en été. Ce genre de protection s'est avéré assez inefficace, puisque 25 ans après sa repose la mosaïque présentait de sérieux problèmes. Le plus important fut le décollement des tesselles de leur lit, surtout des plus petites, ce qui était dû à la désagrégation du substrat en raison des matériaux inadéquats dans le cas de Philippes, comme le sable de carrière qui absorbe l'humidité et le ciment artificiel qui contient une bonne quantité de sels. La désagrégation du liant favorisant la pénétration de l'humidité autour des petites tesselles, l'action alternée du gel et du dégel s'accéléra. Dans la plaine de Philippes l'humidité ambiante, dûe au voisinage des étangs est particulièrement élevée. Aussi, pendant l'hiver, la température tombant souvent la nuit en dessous de zéro, une épaisse couche de gelée matinale d'environ 10 cm couvre toute la plaine, mal aérée, de sorte que l'action de minuscules cristaux de glace qui s'infiltrent aisément sous les tesselles, leur est fatale (Fig. 1).

Il est donc apparu nécessaire de couvrir le prieuré de Philippes par une structure qui réduirait les effets climatiques, et d'entreprendre des travaux de consolidation du support et de drainage. En prenant ces mesures on pensait éviter désormais l'apparition de micro-organismes d'origine végétale, de moisissures favorisées par l'humidité et les sels, et réduire en grande partie la désagrégation du substrat, le décollement et la décoloration des tesselles, en somme on croyait endiguer définitivement l'altération de la mosaïque. Le pavement fut en fait, de nouveau entiérement déposé; dans le nouveau support le sable de carrière a été remplacé par du sable de rivière et le ciment artificiel par de la terre théraïque. Cette opération a rendu encore plus manifeste le micro-déplacement des tesselles de leurs positions initiales, phénomène habituel dans ce genre d'opérations.

La couverture du prieuré n'avait pas pour seul but de protéger le pavement en mosaïque de son exposition aux aléas climatiques, mais aussi de signaler l'existence et la position de cette importante découverte dans le parc archéologique de Philippes.

Toutefois la mise en place de toitures ne constitue pas une mesure préférentielle de protection pour les sites archéologiques en Grèce. Elles font l'objet de vives critiques en raison de leur effet de désintegration de l'unité des sites en tant que champs de ruines. Nous avons le sentiment que cette vision de champs de ruines, qui émane encore aujourd'hui des sites archéologiques en Grèce, a son origine chez les voyageurs européens et dans le regard romantique et humaniste qu'ils posaient sur les antiquités qu'ils rencontraient en Grèce comme cela a été rapporté dans leurs témoignages écrits.

Le cas de l'Octogone présentait une complication supplémentaire: la toiture qu'on se proposait d'installer devait fonctionner à deux niveaux: à la fois, recouvrir le prieuré sans pour autant bouleverser l'unité de l'Octogone qui lui est superposé.

On a envisagé différentes solutions:

1. Une construction métallique légère à voûte recouverte d'une membrane translucide, qui couvrirait le prieuré et qui déborderait vers le centre de l'Octogone et aussi sur le tombeau hellénistique.
2. Une variante de cette construction métallique prévoyait, à la place de la voûte, des toits à deux pans décalés et une prise de jour sur le faîtage, ainsi que la couverture et la mise en valeur de la phiale.

3. La solution suivante, en opposition avec les deux précédentes, ne prétendait pas dialoguer avec le monument, mais plutôt 'antiloguer'. Il s'agissait d'une structure ouverte de type voile, avec différentes variantes, pour couvrir le prieuré ainsi qu'une partie de l'Octogone. La construction, aérée et moderne, ne pouvait pas s'apparenter au monument.
4. En conclusion, on a opté pour un plan géométrique simple et neutre, d'une protection de travail sur une structure tridimensionnelle, portée par six poteaux légers en acier et recouverte de feuilles de polycarbonate alvéolé, qui neutralisent une bonne partie des rayonnements infra-rouge et ultra-violets, et créent en dessous des conditions agréables de séjour aussi bien en hiver qu'en été (Figs 2-5). Cette solution restitue une représentation de la bâtisse du 4e siècle sans la copier, qui, grâce à sa légéreté, évite de contrecarrer l'Octogone. Nous pensons qu'en remettant en place deux des colonnes de la nef de l'Octogone, nous réussirons à atteindre l'équilibre escompté.

La toiture, de 26,88 m de long, 12,88 m de large et 3,45 m de haut a été mise en place par la s.a.r.l. N.- H. Kalokairinos, sous le contrôle du Ministère de la Culture/Ephorie des Antiquités Byzantines de Macédoine Orientale et Thrace, qui réalisa les travaux préparatoires, avec le soutien financier de la Fondation A. G. Leventis.

Depuis la mise en place de la toiture, les contrôles de la température et de l'humidité sont systématiques, ainsi que les observations sur le comportement général du pavement en mosaïque pour pouvoir valuer si le gain résultant de la protection de la mosaïque, son exposition permanente au public et d'autres avantages pris en compte avant la protection de l'ouvrage justifient les soins, la dépense et l'intervention sur le site archéologique de Philippes.

DISCUSSION

Ben Abed: [trans.] If there are comments on this presentation, let us not go into too many details because there is a special session on shelters.

Chantriaux-Vicard: I am afraid I did not understand the nature of the support on which the mosaic was replaced.

Bakirtzis: The mosaic support after restoration comprised a first layer of stones, and then two layers of mortar, and on top of the superficial layer of mortar, the tesserae. This is the traditional manner of support.

Ben Abed: It is a traditional manner of support, a copy of the ancient system.

Name unknown: In view of the construction of the roof, do you still think that the lifting was necessary?

Bakirtzis: The lifting was undertaken just after the excavation in 1962-63, before the roof was constructed. And the roof came twenty-five years later to protect the tesserae

and to arrest the destruction of the mosaic. Now, we are working on the same project at Amphipolis; we are thinking of roofs without the lifting of the mosaic.

Solar: It is very interesting that instead of devoting your attention to another direct treatment of the mosaic, you decided to intervene with the indirect measure of protection. This is, unfortunately, still unusual, because what we still see happening all around is that twenty-five years after the mosaic has been lifted and mounted in cement, the best solution that many people produce is to go back and carry out another treatment, maybe using a different type of cement. What is interesting and encouraging about your paper is that this time you did not consider another direct treatment of the mosaic, but you opted for the much wider solution and you intervened in the environment.

Michalowski: Could you please elaborate a little bit on the designing process of the shelter of the roof? You have shown us four alternatives. Who was responsible for choosing the final solution?

Ben Abed: [trans.] Excuse me. I would like to return to what I said previously. We do not want to enter into a deep discussion because we have a whole session devoted to the problem of shelters. As far as possible, please would you restrict yourselves to the more general discussion.

de Guichen: [trans.] I would like to congratulate the speaker. What he said is very important because for a change he tried to find a solution. The treatment had been applied 20 years earlier; the mosaic was deteriorating fast and he recognized that something had to be done about it. Too often people do not say anything; they brush it under the carpet and they think about something else. I do not know if you have already written your presentation, but could you perhaps elaborate in the written version on that aspect, to explain what happened over twenty years ago before the ideal treatment was available. When you realized that the mosaic was continuing to deteriorate could you perhaps document the deterioration which you were able to observe over twenty years, and explain how much it cost, or what the new solution would cost? It would be a fine example, and would help many people in the future in planning a better solution right from the start.

Bakirtzis: [trans.] Yes, my written presentation is more detailed, but the organizers of the conference are very strict. That is why my oral presentation was limited.

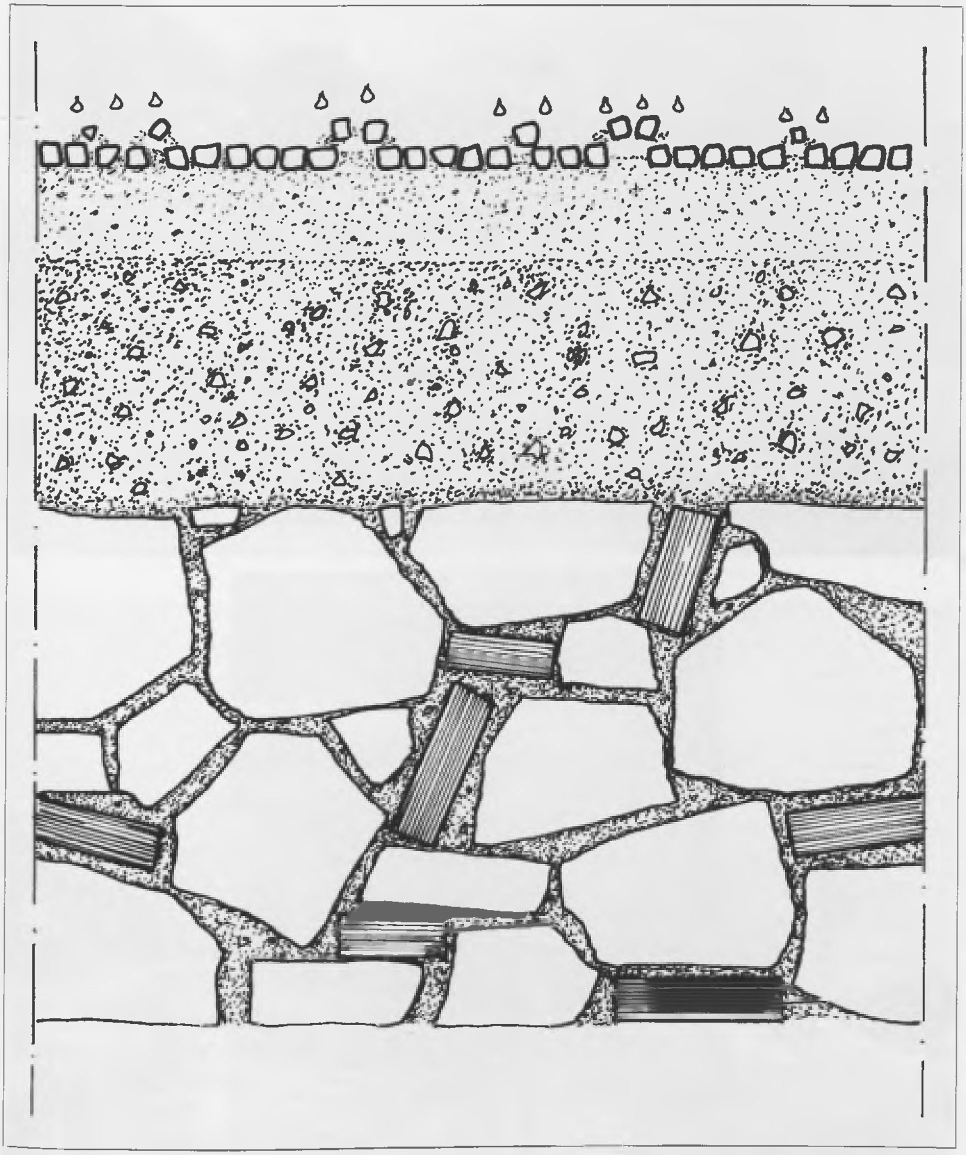


Fig. 1: Philippes. Le substrat de la mosaïque et le décollement des tesselles.





Figs 2-3: Philippes. La toiture du pavement en mosaïque de la "Basilique de Paul" en cours de construction.





Figs 4-5: Philippes. La toiture du pavement en mosaïque de la "Basilique de Paul".

Jake Barrow

The Quapaw Dome project

INTRODUCTION

The Quapaw Dome project is a structural and surface mosaic conservation project planned to reverse active deterioration, stabilize the structure and preserve a historic mosaic. The dome is a prominent decorative roofing on the Spanish Mission revival-styled Quapaw Bathhouse. It was built in 1921 from the design of Mann and Stern Architects, but unfortunately the records detailing the mosaic — the craftspeople, the source of materials and design — have not been found. However, there was a tremendous tile and mosaic industry flourishing at the turn of the century and it would not have been difficult to acquire a design and custom-packaged mosaic for a typical wall or interior project. The dome is an unusual adaptation of the 1920s standard and as such is one of the very few mosaic-clad domes in America. Since the tile consists of glazed terracotta and unglazed ceramic, both rather porous, and since the substructure consists of a relatively thin Portland cement-based plaster, the concept and finish of the dome were surely experimental and whimsical. By the late 1980s cracks, mosaic losses and interior iron exfoliation gave rise to the concern that remedial action was required.

The Quapaw is one of eight bathhouses situated along Grand Avenue in Hot Springs, Arkansas. These bathhouses, the surrounding landscape, mountains on either side of the town and some outlying camp grounds and natural areas are managed by the National Park Service. There are many springs along the eastern mountain slope delivering an abundant supply of 180 °F water which requires chilling before use. The current bathhouses represent the most recent manifestation of a series of structures, the first of which were built in the early 19th century. The bathing industry prospered into the mid-20th century when it began to decline due to changing attitudes. Currently five of the bathhouses are available for lease in adaptive reuse programmes. The buildings are an important part of the town streetscape and were placed upon the National Register in 1974. While bathing for health reasons has seen a decline, faith in the healing and medicinal properties of the drinking waters has continued unabated.

When the National Park Service was established in 1916, Hot Springs became one of the first parks to be included in the system. It had already been brought under federal supervision in 1877 and was first barred from private ownership in 1832. Native Americans made extensive use of the area in Pre-Columbian times and De Soto first announced

its existence to the wider world on September 16, 1541. People began to seek out the Hot Springs waters for drinking as well as bathing.

SCAFFOLDING

Our preservation project began with the decision to conserve the mosaic in place, working on its problems from the exterior and planning structural repairs from the interior. We decided it would be advisable to survey and work on the surface without having to load it directly, so to this end we invented a rotating reusable scaffold ladder. Since the structure of the 23 ft. diameter dome consists of a 2.25-3.5" thick applied cement plaster on plaster wire lath attached to arching channel iron, at first it was thought to be insufficient to carry additional direct live loading. A concrete compression ring at the top bears on a substantial post in the centre of the dome floor. Early in the project the post required stabilisation of the base to ensure solid bearing. Since projected costs for the customized scaffold equalled that of conventional scaffolding, we opted for the custom version, bearing in mind future reuse as well as unlimited availability during the project. Two ladders roll on a track which was fastened to flanges mounted on the substantial concrete base of the dome and a similar connection was made at the top mounting on the compression ring. This system enabled several people to work simultaneously at a convenient distance from the surface with access to all points as required.

CONDITION OF THE SITE

The condition survey and pretreatment documentation consisted of mapping cracks, the mosaic losses, soiling, efflorescence and subsurface voiding. In addition to the through-dome cracking, exfoliation of the interior ironwork was extensive, but not recorded. The ironwork was determined not to play a part in the dome's structure, other than to provide a base on which the plaster was applied. The conditions were recorded on survey sheets dividing the dome into 23 equal sections, or lunes. Each lune consisted of two geometric vertical running patterns starting above the base ring of the tiles and terminating in a kind of egg-and-dart or swag pattern at the top. The geometry provided a simple format to map the dome. After survey and mapping, these sheets were assembled and evaluated in a comprehensive manner, including developing engineering models for the purpose of evaluating structural concerns.

The survey indicated some 1,400 missing tesserae, a radial pattern of through-dome cracking (not uncommon in concrete domes), specialized soiling, voids, delamination of tile surfaces and a congestion of tangential surface cracking on the south side. Some ideas emerged from the survey.

Since the interior has been a very humid environment, we believe that the variation in dew point in some areas contributes to higher levels of localized wetting. The consequences of this would be that moisture levels in the substrates would vary and contribute to damper areas even at the setting bed of the tiles. The unheated space of the dome in-

terior is also responding to localized temperature variations, particularly on the south side, which can create unequal thermal stresses. The cold joint at the base of the dome appeared to be poorly finished. The extensive losses at the top area of the dome were readily attributable to some failures of the cupola base flashing and moisture infiltration at the top edge of the mosaic which terminated without flashing or cement finish. Water entered at the termination point, flowing under tiles in several areas. Through-dome cracks often aligned with the channel iron beneath, as this was the thinnest section of the dome and thus the weakest point.

CONSERVATION

Our plan for repair followed a two-track course: conservation of the surface and structural considerations. We decided to achieve weather seal and drying out simultaneously, while evaluating the structure. Potential interventions included planning for shotcrete of the interior surface and/or re-ribbing with non-corrosive metals. We assumed that this work could be accomplished after mosaic conservation by using non-vibratory methods so as to avoid disturbing any completed exterior surface work.

Mosaic conservation involved injection of Jahn Grout M-40 in voids beneath the mosaic and into cracks. Cement substrate testing indicated that the Jahn M-40 was very close in compression and tension to the existing cement. A total of 70+ litres was injected into all areas of loss in the dome. Direct methods were used to replace tile losses, using custom-made replacement glazed terracotta tesseræ. In some locations tile surfaces were re-adhered with acrylic resins. Once cleaned, grouted, repaired and cured, PROSOCO Weather Seal Siloxane WB water repellent was applied as a final treatment. Siloxane had proven effective on some nearby wall tiles in the next bathhouse. It will be necessary to revisit the repellent after several years to ensure its continued efficacy.

Planning for structural repair included modelling the dome and testing the capacity of its cement substrate. Reinforcing steel was not considered worthy of testing due to its advanced state of deterioration. Seven samples of cement plaster sections with and without tiles were taken and submitted to a battery of tests, including compression, tension, elastic modulus and petrographic identification. Results indicated higher than expected performance capability, no chlorides or aggregate problems and complete carbonation of the cement. These test results were configured into engineering programs and applied in modelling schemes, such as the Mohrs diagram examining maximum principle stresses across the element. Thermal stresses localized in the lower area of the south side emerged as the only cause for concern based upon assumptions brought to the calculations. We opted for a cautiously temporal and conservative approach to modify the environment, monitor the conditions and dome and to postpone a final decision on structural intervention until further understanding of the active issues could be realized. Plaster telltales were installed on interior areas over existing cracks and remote monitoring data loggers were designed and planned for installation. Active ventilation was planned and the expectation of being able to modulate thermal effects through environmental

controls became an alternative to the proposed shotcreting and/or re-ribbing solutions. Should these relatively cheap methods prove effective, then the park could avoid major costly restructuring of the dome in the near term. Thus our recommendation to observe the dome defined the solution.

The project was locally very popular and replacement of the cupola provided a dramatic close to the physical fieldwork. Similarly, in 1921, when craftsmen had completed their construction tasks, the moment was captured on film.

ACKNOWLEDGMENTS

The team for the Dome project consisted of the author as conservation project manager, Barry Welton of the Denver Services Center, NPS as general project manager and chief structural engineer, assisting engineers Becka Renaud and Steve Shremp of the Denver Services Center, Garry Smith, NPS mason, architectural conservators Anne Oliver and Bob Hartzler. NPS architect Ray Yunk served as park project coordinator. Material testing by Erlin, Hime Associates of Wis, Janney, Elstner.

DISCUSSION

Ben Abed: [trans.] This is rather different from the ancient mosaics; it is a contemporary mosaic, and it raises different problems as these are twentieth century materials. Personally, I would have liked to know more. I say so because we have discussed it together, the decision-making process and the planning process decision.

Nardi: I am very interested in your planning for the maintenance system for the future. This is a really a great demonstration of thinking ahead. This means that you not only planned the future risks of damage and how to prevent it, but you have also already established the measures to be taken. This also means that the future solution will be much cheaper than it might have been. I would like to ask whether you made any calculation of the costs of future maintenance?

Barrow: As you may know, in the National Park Service, we manage and care for our monuments internally, and in many cases we have staff already paid who can perform some of the routine tasks, for instance, checking the dome for water repellent and things such as that, maybe some minor repairs to mortars. So, the main consideration for me was the scaffolding, because I felt that with this insubstantial sort of covering on the dome, that surely we would be back there at some time. It is already now seventy years old, and we have these kind of losses on a small percentage, maybe only five percent. It is not a very serious problem, but left to go, it would have accelerated. We are hoping that the water repellent will extend that lifespan, but certainly, when we estimated our scaffolding cost, we did a very finite estimate for that, and it cost the same amount of dollars to build the custom scaffolding as

it would have cost to lease the tube-and-clamp scaffolding, which we would have had to give back. Plus the fact that the scaffolding is much more efficient. The next time around, the scaffolding, which in fact is quite expensive, as you know — some fifteen to twenty thousand dollars for something like that — is going to stay in place for maybe six or seven months because we need to install the scaffolding in order to make a complete survey and then have time to plan all of the intervention, which is only partially planned.



Fig. 1: A section of the Quapaw Dome with a through vertical crack (photo by Jake Barrow).



Fig. 2: Injection grouting to re-adhere delaminated surface (photo by Anne Oliver).

Fig. 3: Deteriorated and delaminated surfaces (photo by Bob Hartzler).



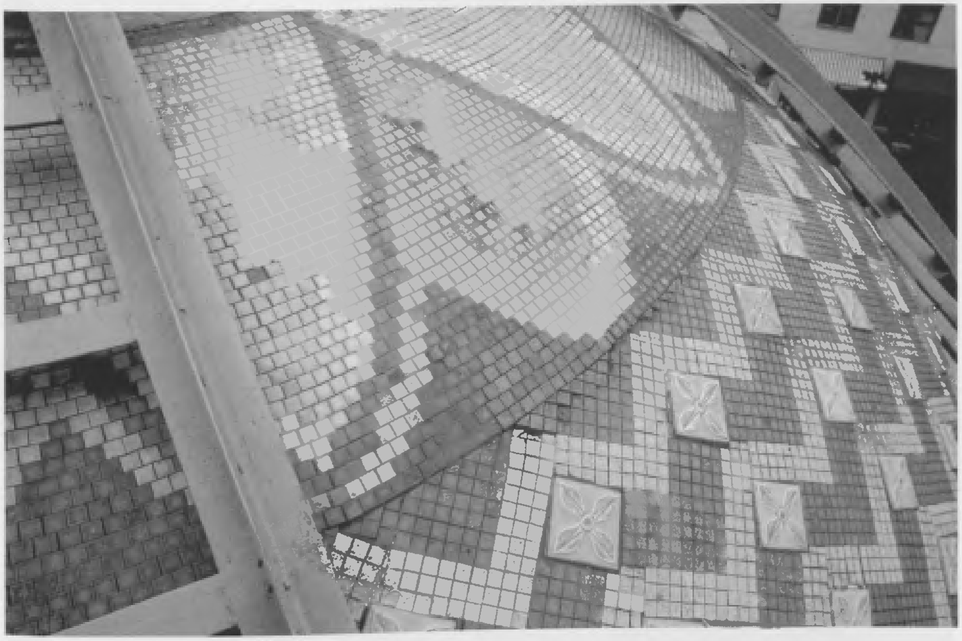


Fig. 4: Close-up view of mosaic surface after repair (photo by Bob Hartzler).



Fig. 5: Piece-by-piece restoration of lost tesserae (photo by Bob Hartzler).



Fig. 6: View of dome with rotating scaffolding in place (photo by Jake Barrow).



Fig. 7: The Quapaw Bathhouse (photo in Hot Springs National Park collection).



Fig. 8: Replacing the copper cupola after restoration of dome is complete (photo by David Vann for the Arkansas Sentinel - Record).

Carol Edwards, Mike Corfield, Barry Knight, Jeanne Marie Teutonico and John Adams

The investigation and conservation of 4th century AD mosaics at Brading Roman Villa, Isle of Wight, England

INTRODUCTION

Brading Roman Villa is located on the Isle of Wight, off the south coast of England (Fig. 1). Excavations in the 19th century revealed fine 4th century mosaics in the west wing (Fig. 2). Since then, protected by a corrugated iron covering building, the Villa and its mosaics have been displayed to the public.

In recent years, the condition of the mosaics has been deteriorating, due both to the building's problematic setting at the foot of a hill slope and to lack of funds for conservation and maintenance. Two flooding incidents in 1990 and 1994 exacerbated the situation and led English Heritage to develop a planned programme of investigation and conservation for the Villa and its mosaics.

The aim of the programme is to stabilize the Villa and its environment and to conserve the mosaics *in situ.*

DESCRIPTION AND CONDITION OF THE MOSAICS

Mosaics survive on their original lime mortar bedding in three rooms of the Villa.

Room 1 - The corridor has blue/grey and red chequer-board tessellation with an Orpheus mosaic in the entrance hall. The blue/grey chalk marl tesserae are cracked and fragmentary and lacunae have been infilled with concrete or poorly restored in previous repair campaigns. A corn-drier, cut through the chequer-board tessellation in antiquity, is supported by a wooden frame and the concrete infilling is cracked and detached (Fig. 3).

Room 11 - The central geometric mosaic, discoloured by the effects of heat, is surrounded by a wide border of coarse cut red tile tesserae.

Room 12 - This room consists of two chambers. The west chamber features a mosaic of the Seasons and a panel depicting Perseus and Andromeda. A connecting panel featuring an Astronomer leads to the east chamber, where the central medallion of Medusa is surrounded by pairs of mythological figures and the four winds (Fig. 4). To the east is a frieze depicting sea-centaurs, nymphs and a bi-tailed merman.

The mosaics in this room are of high quality design and workmanship, but they are now in a fragile state. The tesserae are becoming detached from the setting bed and raised ('blown') bulges have formed. Two hollow ridges run north to south, one through the West Wind and the other through the Sea-life Frieze. Along the top of the ridges, cracks have developed and tesserae are beginning to collapse (Fig. 5).

PLANNED PROGRAMME OF INVESTIGATION AND CONSERVATION

A planned programme of investigation and conservation requires an ordered approach whereby some stages are undertaken sequentially and others concurrently.

At Brading Roman Villa, it was first necessary to create a management structure which would facilitate project funding and organization. This was followed by the investigation and recording of the site and its environment so that detrimental conditions could be rectified and controlled prior to any actual conservation work on the mosaics.

In brief, the project involved a number of stages. Firstly, recognition of the mosaics' deteriorating condition and of their importance within the Romano-British corpus. Secondly, the involvement of English Heritage and the creation of a multidisciplinary team of professionals with relevant experience to guide the project. The assembled project team included conservators, archaeologists, scientists and architects who met at regular intervals to assess progress and to make decisions regarding future phases. This interdisciplinary approach was critical to the success of the project. It ensured an integrated planning process in which the mosaics were always considered in the larger context of their built and natural environments. Thirdly, the Villa was transferred from private ownership to the Oglander Roman Trust in order to facilitate its application for grant funding from English Heritage and other sources.

A series of inter-related investigations was conducted. A visual survey of the Villa environment was carried out, which identified a number of problem areas. These included the deployment of agricultural activities involving heavy machinery in close proximity to the west wing, the location of the villa at the foot of a hill slope, allowing flood waters to drain into the villa and the presence of spoil heaps against the back wall of the villa which provided habitat for vegetation and local wildlife. Trial trenches were excavated outside the cover building to better understand archaeological and geological features of the site. A condition survey of the covering building was conducted to identify areas for repair and maintenance.

As described by M. Corfield in his keynote address (this volume), a precise three-dimensional framework was created by means of accurately surveyed points on the mosaic floors. With these in place, both black and white and colour photographs were taken to create 80 stereopairs. From this survey, an accurate photo-mosaic was created to provide a base for all future condition recording. In addition, the colour negatives were scanned into a digital photogrammetric workstation in order to generate a digital orthophotograph of the mosaics, providing very accurate representations of the mosaic relief.

In addition, the floors were surveyed by pulse radar in order to identify zones of reduced structural support in the bedding foundation mortars at given depths, as well as

voids or deconsolidation of the setting-bed beneath the tesserae. This non-destructive technique permitted the identification of problems below the surface which could otherwise have been revealed only through destructive excavation and lifting of the mosaics.

The relative humidity and air and surface temperatures, both inside the villa and externally were monitored. Sensors were placed in various locations, including into the bedding mortar, and linked to data loggers to detect variations within different areas of the Villa and to assess the drying of the mosaic floor after the flooding incidents. Information was also gained regarding the relationship of external conditions to internal ones at different times of the year.

A condition survey of the mosaic floors was conducted by means of visual assessment and traditional tapping methods in order to detect various conditions and decay products, including lacunae infilled with concrete, areas restored since excavation, missing, deteriorated or discoloured tesserae, voids or detached layers, detached 'blown' areas forming bulges or ridges, surface subsidence, surface cracking, salt efflorescence, black and white surface deposits, algal growth and unusual construction features.

Conditions were recorded on the composite photo-mosaic. Photographs were also taken to illustrate typical conditions. Comparisons were made with excavation photographs to evaluate deterioration and to identify areas of previous restoration. The mosaic materials and construction, including the foundations where visible, were also recorded. Where relevant, external and internal environmental factors were noted in terms of their relationship to observed decay phenomena.

STABILIZATION OF THE VILLA ENVIRONMENT

In order to permit *in situ* conservation of the mosaics with minimum intervention, it was first necessary to carry out preliminary measures aimed at creating a more stable environment for the Villa.

The surrounding agricultural land was purchased in order to curtail further damaging agricultural activities. A drainage scheme was designed and installed to prevent further flooding without causing the foundations to dry out excessively with resultant shrinkage and cracking. This involved the creation of a deep drainage trench in the hill slope and a revision of the cover building's rainwater system. The spoil heaps to the rear of the villa were removed so as to eliminate the habitat for small burrowing rodents and to divert rainwater run-off.

Basic repairs were carried out to the cover building and a regular maintenance programme was developed. Some preliminary proposals have also been developed for a new covering structure should additional funding become available.

RESTRICTION OF ACCESS TO THE MOSAICS

In the past, Villa staff lectured to visitors while standing on the mosaic floors. This practice has now been abandoned and lectures are given from the raised wooden path-

ways. Similarly, when staff must access the mosaics, they do so via the coarse cut red tile tessellated areas. Staging boards (narrow boards supported at both ends on padded blocks) are used whenever the central part of the mosaic is to be examined.

CONSERVATION OF THE MOSAICS

The order in which the mosaics were to be conserved was carefully considered, taking into account the environmental changes and the condition of the various areas. Information gained from initial campaigns, regarding both archaeology and treatment techniques, would inform subsequent conservation work.

With these considerations in mind, it was decided that conservation work should commence in Room 1 on the chequer-board corridor, the corn-drier and the Orpheus Mosaic. Subsequent phases will address, respectively, the east chamber of room 12, the west chamber of room 12 and finally the geometric mosaic in Room 11. Room 1 was selected as the first area for conservation as it was in poor condition, unsightly and less likely than Room 12 to be affected by possible changes in environment caused by the new drainage scheme. Room 12 was flooded more extensively than Room 1 and is in more fragile condition. Thus, the experience gained in the first phase of conservation will be important in dealing with the more complex conditions in Room 12.

The east chamber of Room 12 is planned for the second phase of conservation as work is urgently required to prevent further collapse of the hollow ridges. There will be an evaluation period after this phase of the works to monitor the effects of the conservation treatments before commencing work in the west chamber. An experimental programme has been initiated to determine the composition of the mortars to be used for injection grouting of voids and ridges. Formulations based on limes and hydraulic limes are under consideration and will be evaluated for their compatibility with the historic materials.

The final phase will address the mosaics in Room 11, utilizing similar techniques to those employed in previous phases.

CONCLUSIONS

In order to be successful, *in situ* conservation of mosaics must address not just the artifacts themselves but their built and natural environment. Decisions must be based on thorough knowledge of materials, construction, site history and conditions, as well as the inter-related factors contributing to decay. Issues of presentation, use and maintenance must also be taken into account. In short, the site must be understood as a complex and dynamic system rather than just a container for precious decorative remains.

In the case of Brading Roman Villa, an interdisciplinary team of conservation professionals developed an integrated planning approach which allowed all aspects of the site to be considered in a logical and phased project. Information gained in preliminary phases of recording, investigation and monitoring led to a better understanding of the site's

topography, hydrology, climatic conditions, construction and use, as well as the factors contributing to its decay. This in turn led to a series of interventions aimed at eliminating causes of decay and stabilizing the villa environment before any conservation work began on the mosaics themselves.

The conservation of the mosaics in Room 1 has now been completed and phase 2 will begin in late summer 1996. In the light of information gained through the conservation project, plans are in development for the reorganization of the Villa's interpretative displays, so as to present better the villa and its mosaics to the visiting public.

ACKNOWLEDGEMENTS

Steve Trow, Ancient Monuments Inspector, English Heritage, has also greatly contributed to this conservation project. Thanks are extended to the staff at Brading Roman Villa for their cooperation and assistance. Photographs were taken by Carol Edwards, Southern Archaeology, for English Heritage.

DISCUSSION

Ben Abed: [trans.] This very elegant presentation demonstrates that when decisions are taken and planning is properly devised, obviously the intervention results are remarkable. It is also interesting because you have been working on a site which was excavated previously. It is important for us all because there are large numbers of enormous sites that we have inherited, sites on which we will have to work. Your experience is of great interest to us.

Menicou: [trans.] For all these years, what did the responsible department or the curator do to prevent conditions deteriorating to the level which has been reached now? Were small repairs and conservation jobs undertaken every so often on the site? What have they done all these years — just lay cement, or what?

Edwards: Yes, we cannot take all the previous treatments out, but there has been an ongoing programme. As I mentioned earlier, the mosaic, the villa, was owned by a private family. There was a curator in the villa who was employed by the Archaeological Unit and partially by the private owner. And a few years ago he did get in touch with me, and we put together a research design which is very similar to what has happened now. We did try to get it sorted out then; we tried to encourage people to assist us, but we did not have much success; rather, we had no success because it was turned down. It was not until the second flood really developed that we have this assistance now, and even then I heard people mention the difficulty of carrying out certain programmes without the assistance. This project really would not have been possible without the intervention of English Heritage. The curator, myself, a conservator in a unit. We have not got the authority or the access to the architects,

engineers, the range of specialists that authorities like English Heritage have. This project has been such an interesting one for us, the local conservators; we have involved a local conservator who has been working on the floors with me so that later on he can monitor the floors and not necessarily need my presence there.

Guidobaldi: [trans.] I wanted to ask you why you believe that some draining work outside the villa might be hazardous. I believe that it is possible to drain the field outside the villa, there might be a reverse transport of salt which might be dangerous to the mosaics. So, a way to ensure protection might be to dig a trench around the villa. Also, I would like to know whether a heating system was found within the villa.

Edwards: The drainages outside the villa, and part of the trench around it, are a drainage system to stop this flood water. Of course both seem to be surface water plus drainage water underneath from the downs that are at the back of the site. Basically, though, the drainage has been left to the drainage engineers. I cannot comment on their choice of drainage schemes; we explained what we wanted in the sense that we wanted to stop the ground water draining off the downs, coming through the walls at the west of that Room 12. So, we merely gave the engineers what we wanted and said we did not want the villa to dry and left it to the engineers to actually devise the scheme. And the archaeological trenches were dug before the drainage was dug to ensure there was no disturbance to the archaeology.

Barrow: This is rather a general question, maybe for the audience. In your example, you indicated that you were not walking on the mosaic, nor were you walking or standing on the mosaic when you were working on it. I am curious as to whether on other sites in the Mediterranean area this is a common practice. In my experience, a few years ago, anyway, the sites were generally open and you could walk across the mosaics. Should there be a theory about that?

Edwards: It might, perhaps, be better for the Mediterranean countries themselves to say whether it is done. The reason we did not walk on the mosaic, the fragile parts, is that there are so many hollow bulges on them and we feel that the pressure will cause them to collapse. There are areas where we do walk on the tessellatum. We have almost pathways across the floors. You are allowed to step on the red-cross tessellatum, which is reasonably secure. You are not allowed to step on the crumbling gray chalk tessellatum. You can walk around the red tile borders; you cannot walk on the fragile mosaic areas. And we use these platforms that we've bought, stagings, which can be moved, and they are very simple. We've simply got wooden blocks wrapped with something called bubble wrap, which you may know. And we have them raised up, and we just move the box along and move the staging. It is extremely simple and not very expensive. If anyone wants to walk on boards it is very simple to devise.

Weidmann: [trans.] I am an archaeologist in charge of site management, management of a site which is quite similar to yours. Given the damp conditions that are prevalent on the site, do you intend to do something within the building itself?

Edwards: We have now found that the damp conditions have gradually receded and this is now dry, as you saw from the salt efflorescence. We have left the salt efflorescence on at the moment because we are going to have a cleaning programme later on. So, we're not going to do anything with regard to drying; it is naturally drying quite gently on its own. I am also pleased to see that during the work it is not drying too rapidly. Because when we put the platforms I was just mentioning down in certain areas of the villa, the moisture is being gradually drawn up because of the polythene. But it indicates that there is moisture there. So, we are not doing anything in the villa to dry it, just letting it dry gently and naturally.

Ben Abed: [trans.] If I may, I would like to put the following questions. For the moment you have been making a diagnosis, and I would also like to have an idea about the overall cost that was incurred so far in the present phase of restoration that you have envisaged.

Edwards: I can tell you the cost of the conservation of the mosaic side, but I have not got the figures for the actual cost of the drainage, the archaeological investigations. And Mike Corfield, who is co-author, may possibly have these figures of the overall costs. He has estimated that the total cost at the end of the mosaic would probably be in the region of about 66,000 pounds, and that is for all three rooms. Now, this is just an estimate.

Name unknown: How many square meters?

Edwards: It is probably about eighty-five square meters. You know, it is rather embarrassing in Britain. We don't have a lot. [Laughs]

Corfield: I don't know whether I can add much to the question of the cost. Our total budget for the campaign from the evaluation through to the treatment that Carol is carrying out now is about 100,000 pounds. But that does not include the cost of our own resources, our own personnel who are working on this project, my own costs and the costs of the engineers and archaeologists. If these were added in, I would have said that we would probably be looking at costs of about 150,000 to 180,000 pounds. That will take us up to the point when the floors are as stable as they possibly can be and the major causes of deterioration have been alleviated. The next phase beyond that is totally uncosted — the cost of putting up possibly new cover buildings, new interpretations and so on. That is about as far as we can go, I think.

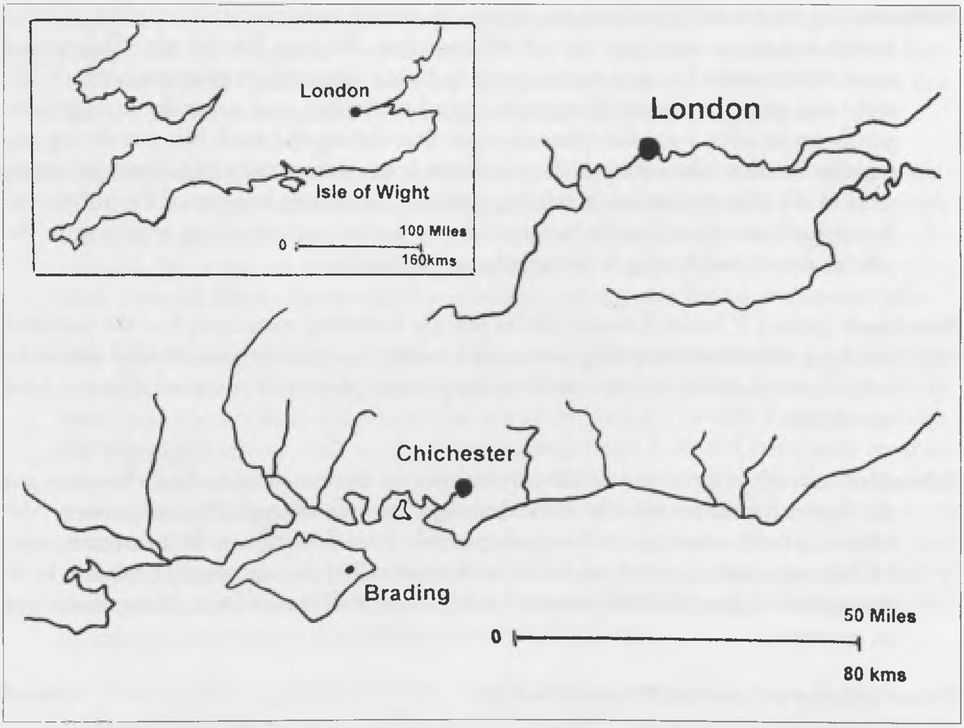


Fig. 1: Location Map, Brading, Isle of Wight, England.

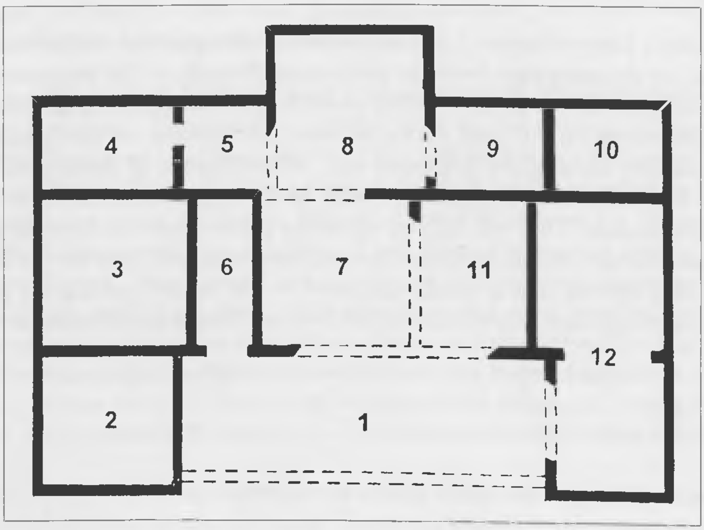


Fig. 2: Room Plan, West Wing, Brading Roman Villa.



Fig. 3: Room 1. Chequer board tessellation with a post-Roman corn-drier cut through it.

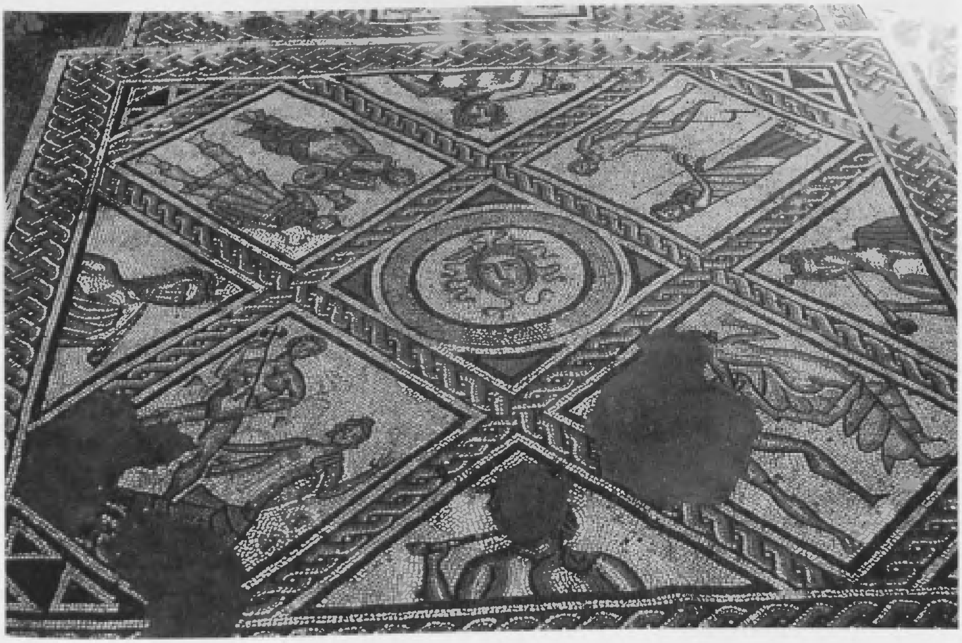


Fig. 4: Room 12. Medusa mosaic.



Fig. 5: Room 12. Sea-life frieze: hollow ridge and collapsing tessellation across bi-tailed merman.

Milena Necaskova, Francesca Piqué and Dusan Stulik

Problems and solutions: *in situ* conservation of The Last Judgement mosaic in St. Vitus Cathedral in Prague

MOSAIC HISTORY AND ICONOGRAPHY

The Last Judgement mosaic decorates the entrance, called the 'Golden Gate', of the south side of the St. Vitus Cathedral in Prague. The mosaic is one of the few examples of mediaeval monumental mosaics north of the Alps. The date of the mosaic's origin has been established by two notes recorded by Beneö Krabice of Weitmile. In 1370, Beneö wrote: "In this time the Emperor has ordained a picture, beautiful and costly, to be executed from glass in the Greek manner above the portico of the Prague Cathedral". The following year (1371) he announced its completion: "This year was completed the solemn picture which the Emperor ordained...".

No other contemporary records have been preserved and the Beneö chronicle remains the only source of information on the origin and execution of the mosaic.

The mosaic originally occupied about $97m^2$ of the Golden Gate surface, but only $84m^2$ remains due to the mosaic's deterioration through the ages. The mosaic is composed of three panels (Fig. 1). In the middle section is the figure of Christ sitting in judgment in a rainbow-coloured arch (mandorla) and surrounded by angels. Below Christ is a group of the patron saints of Bohemia. At the bottom of the central section of the mosaic are two wedge-shaped spaces that contain a portrait of Charles IV on one side and, on the opposite side, his fourth wife, Elizabeth of Pomerania.

In the left panel of the mosaic, six apostles and the Virgin Mary are depicted above a scene representing the 'Resurrection of Man on the Last Day'. In the right-hand panel of the mosaic is a second group of apostles and St. Joseph above a depiction of the damned in Hell.

There are many interesting and open questions regarding the authorship of the mosaic and the degree of participation of domestic and Italian artists and artisans during the mosaic's execution.

HISTORY OF CONSERVATION TREATMENTS [1]

Bookkeeping records document the first mosaic restoration in the late 15^{th} centu-

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[1] This section is a summary of the extensive historical research carried out as part of the project. Ad-

ry. Other accounts describe another restoration in 1534. In 1541, a fire destroyed a large area around the Prague Castle, including some parts of the St. Vitus Cathedral. It is likely that the mosaic needed restoration work after the fire. In 1619, the Protestant King Federic of Pfalz ordered the covering of the mosaic with plaster, but after his defeat King Ferdinand II (1619-1637) ordered the mosaic to be cleaned and preserved for future generations. There are no records of work on the mosaic in the 18th century. However, during the first half of the 19th century the mosaic was restored twice. During this time the loose parts of the mosaic were reattached using large-headed nails and mastic-based adhesive. In the upper portion of the mosaic, the large missing areas were filled with painted plaster.

A renewed interest in the mosaic at this time was connected with the activity of the Association for the Completion of the St. Vitus Cathedral. A detailed examination of the mosaic was made in 1879, when discussion about major restoration of the mosaic began. The final decision to detach the mosaic from the Cathedral wall was taken following a windstorm in February 1890 which caused several square meters of the mosaic to fall down and be lost. A decision based on the advice on an international committee of mosaic specialists was to remove the mosaic from the Golden Gate. During the summer of 1890 the whole mosaic was cut into 274 separate pieces and detached from the stone wall of the cathedral. At this time it was not clear if the mosaic would ever be re-installed. During the mosaic removal it become clear that the original mortar layers of the mosaic had deteriorated and had lost their cohesion.

Several years of study and restoration of the mosaic revealed that underneath the surface corrosion the mosaic tesserae were in good condition. Based on the success of the restoration work, it was decided that the mosaic could be repositioned in its original location. In 1910, corresponding with construction work completing the cathedral, the 274 sections of the mosaic were repositioned with new cement-based mortar on the façade. Missing tesserae were replaced with modern coloured glass and gilded tesserae that are still clearly visible today.

Forty years after the reinstallation of the mosaic, the surface of the mosaic had become heavily corroded from exposure to the environment. In 1953, Czech restorers and scientists began a comprehensive scientific study of the mosaic's deterioration. This led to the cleaning, restoration, and re-gilding of the mosaic and the application of a protective multi-layer polymer coating, which was completed in 1960. Due to lack of periodic maintenance recommended by the restorers, the coating was not effective in preventing subsequent deterioration of the mosaic. By 1967 Czech conservators noticed a delamination of the protective layer and new corrosion of the glass. Since then, several treatments have been tried to save the mosaic. However, these attempts, prompted by upcoming important political and cultural events, targeted only the aesthetic effects of the mosaic and did not address the cause of its deterioration.

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ditional information and references can be obtained from the original report: M. Necaskova and J. Rathousky, "The history of the conservation and restoration treatment on the Last Judgement Mosaic in Prague", The Getty Conservation Institute. Unpublished report (1993).

ORIGINAL TECHNIQUE AND CONSERVATION PROBLEMS

Technological studies during the last two major restorations and conservation campaigns (1890-1910, 1950s) provided much information on the original internal structure of the mosaic. The smooth stone wall was roughened and two-headed stone-mason's nails were hammered in a regular grid distance of 37.5 cm (the historical measure of one 'shoe') and joined by a crossed wire. The resulting mosaic support was covered with coarse lime plaster that was later roughened to improve adhesion of fine mosaic plaster. That layer was fortified with brick powder and egg white. To this layer individual glass tesserae were applied. The great majority of the mosaic's one million glass tesserae are still original. A total of 31 different colours of glass were used in combination with natural stones (quartz, opals and chalcedonies), which were used for flesh tones (Fig. 2).

At present, the once-glittering and colourful mosaic is covered by a sometimes uniform, sometimes patchy greyish-white and greyish-brown layer (see Fig. 1). As Beneö observed in his 14th century account, the mosaic's colour scheme becomes more visible when rainwater saturates the mosaic surface. This and other historical records confirm that problems of legibility of the mosaic due to the presence of a superficial corrosion layer is not a modern one.

The chemical composition of the mosaic glass combined with the exposure to the elements is responsible for the recurring conservation problems of the Last Judgement mosaic. A relatively low concentration of SiO_2 (46-57%), together with a high concentration of CaO (12-20%) and a very high concentration of K_2O (15-20%), and only a very low concentration of Na_2O (<1%), is fairly typical for the composition of medieval glass from Central Europe. Moreover, because only low oven temperatures were used in the glass production, the resulting glass is heterogeneous and rich in air bubbles (Fig. 3). As a consequence of both its composition and its high heterogeneity, this glass has been very vulnerable and prone to corrosion.

The basic chemical reaction responsible for corrosion of glass is the hydrolysis of the siloxane chains at the surface of the glass due to the reaction with water. This reaction takes place as follows:

$$\ldots - \mathrm{Si} - \mathrm{O} - \mathrm{Si} - \ldots + H_2O \rightarrow \ldots - \mathrm{Si} - \mathrm{OH} + \mathrm{HO} - \mathrm{Si} - \ldots$$

In glass with a high content of potassium (or sodium) another reaction also takes place:

$$\ldots - \mathrm{Si} - \mathrm{OK} + H_2O \rightarrow \ldots - \mathrm{Si} - \mathrm{OH} + \mathrm{KOH}$$

Through the introduction of water a silicic acid gel is formed on the glass surface. The presence of alkalis on the glass surface accelerates the formation of the silicic gel. If

alkalis present in the gel are not washed away by the rain, they react with air pollutants (SO_2), forming a white corrosion layer which causes the current greyish appearance of the mosaic (see Fig. 1). Corrosion products have been analysed and among many different simple and complex potassium, calcium sulfates and silicates, the most abundant have been found to be gypsum $CaSO_4 \cdot 2H_2O$ and syngenit K_2SO_4 x $CaSO_4$ x H_2O.

THE GCI PROJECT

In November 1992, the Office of the President of the Czech Republic and the Getty Conservation Institute signed an agreement to collaborate towards research, documentation, restoration and conservation of the Last Judgment mosaic. The project targets were:

1) a review of available historical documentation including reports from previous restoration treatments.
2) the collection of all available historical images of the mosaic (photographs, painting, and etchings) to look for any evidence of the mosaic's deterioration prior to the 1890-1910 restoration.
3) the creation of a detailed recording of the present condition of the mosaic.
4) the recording of environmental parameters in the vicinity of the mosaic, and long term monitoring of the surface temperature and time of the wetness of the mosaic.
5) the evaluation of available cleaning methods for the removal of the corrosion layer and selection of appropriate technologies for surface cleaning with minimum damage to the glass surface.
6) research on coating technology and identification of appropriate protective material, including an extensive series of laboratory, *in situ* and artificial testing.
7) the development of a conservation plan based on the choices for cleaning and coating of the mosaic.
8) the preparation of a detailed recording of the mosaic after removal of the corrosion layer. This information will be used as the base line documentation for future monitoring, maintenance and conservation of the mosaic.
9) the development of a rigorous but flexible long-term maintenance programme for the mosaic.

PHOTOGRAPHIC DOCUMENTATION

In 1994 and 1995, the mosaic was photographically documented with over 1,300 images which were transferred to photo-CD for computer analysis. In addition, an extensive collection of historical photos has been assembled to study previous condition treatments and the rate of deterioration between restoration treatments. Both modern

and historical images are now being used for a detailed condition survey that records the state of the mosaic before, during and after conservation treatment.

CONDITION SURVEY

During the first phase of the conservation project, the project team, joined by an international team of conservators and scientists, assessed the condition of the mosaic. They found a layer of corrosion products, deteriorated background gilding, missing tesserae and cracks in the mosaic's plaster support. Removal of the white corrosion layer in several test areas has shown a relatively good state of preservation of the original glass. The mosaic's adhesion to the wall of the Golden Gate has been found to be satisfactory and no major subsurface delamination has been found.

The conditions of the mosaic were recorded on transparent sheets placed over a photograph of a section of the mosaic. Information being recorded includes types of tesserae, missing tesserae, fissures in the mosaic, repaired and reconstructed areas, mosaic delamination and the extent of the corrosion layer.

The conservation treatment will be graphically documented in a similar way. Moreover, during cleaning, the condition survey will be extended to add information on existing gilding, colour fields and analytical data on corrosion products and the mosaic glass. This documentation will provide baseline data for the long-term monitoring of the mosaic.

ENVIRONMENTAL MONITORING

Surface moisture, air pollutants and mechanical stress resulting from extreme temperature changes have been identified as major causes of the mosaic's deterioration. To understand the effect of environmental conditions on the stability of the mosaic and to determine conditions needed to produce test environments for the evaluation of protective coatings, an environmental monitoring station was installed on the St. Vitus Cathedral in the spring of 1993. The monitoring station measured air temperature, relative humidity, surface temperature and moisture level, wind speed and direction, and solar radiation.

For two years data were collected at 15-minute intervals and processed and analysed at the Getty Conservation Institute laboratories. Analysis showed surface temperature changes of more than 80 °C. On nearly 80% of the days between November and March the surface reached a near-wet condition (the primary cause of corrosion) from either rain or moisture condensation.

CLEANING METHODS AND MATERIALS

Conventional mechanical and chemical cleaning methods are very harsh and therefore inappropriate for removing the corrosion and previously applied coating materials

from the fragile mosaic. Through a series of *in situ* and laboratory tests, a new cleaning methodology based on air jet technology and new, mild abrasive materials was developed. Details of this research will be published elsewhere.

PROTECTIVE COATING

The primary focus of scientific research efforts is the development and testing of a surface coating that will protect the mosaic from moisture and pollutants. The protective coating must have the appropriate barrier qualities and offer excellent optical properties, good adhesion to the glass surface, and stability when exposed to UV radiation and temperature changes. The selected coating material must allow for future conservation treatments.

Since water and sulfur dioxide (SO_2) have been found to be primary agents of corrosion, a multi-layer coating system that will protect against both is being developed and tested. *In situ* and laboratory tests of coating materials and techniques are being conducted by the Getty Conservation Institute with the assistance of the Fraunhofer Institute in Würzburg, Germany and the Department of Material Science, University of California, Los Angeles.

AESTHETIC PRESENTATION (RE-GILDING)

While the scientific research continues for the identification of the best protective coating system for the St. Vitus mosaic, the issue of aesthetic presentation will be addressed from the theoretical and ethical point of view by a committee of experts in the autumn of 1996.

As part of the late 1950s conservation, the background of the mosaic was re-gilded by adhering new gold leaf on the top of the original tesserae with an epoxy-based adhesive. This is the last known re-gilding of the mosaic. The *new* gilding added then is now deteriorated while the gilded replacement tesserae added earlier (in 1910 when the mosaic sections were repositioned) have maintained their gilded appearance. The resulting optical effect is of a gilded grid on a darker background. This is particularly evident in the central panel (Fig. 4). The same effect occurs on the rest of the mosaic's originally gilded background and will be even more apparent once the tesserae are cleaned and the white glass corrosion products removed.

MAINTENANCE CYCLE (THE FUTURE OF THE PROJECT)

A primary concern is that all conservation procedures and materials are thoroughly tested to ensure the long-term preservation of the mosaic. Restoration work, which will include cleaning, replacement of missing tesserae and coating and partial re-gilding, will take place after all tests have been completed and analysed. It is anticipated that work on

the mosaic, to be performed by an international team of conservators, will begin in 1998. A plan for periodic maintenance and monitoring of the mosaic is also being developed by the project team.

DISCUSSION

Ben Abed: [trans.] I must say I am fascinated by this extraordinary project. Of course, it is an outstanding masterpiece, and to my mind what has been done is what should be done for many other masterpieces in the world.

Edwards: As a conservator, I have been involved with the conservation of some wall mosaics with deterioration of the bedding layers in which the tesserae are set, and also actual deterioration of the glass tesserae themselves. But I would be concerned about putting a surface coating on the actual tesserae, that you might then be causing further problems, perhaps of salt crystallization in the bedding layer, which could then result in a whole lot spalling off the surface.

Piqué: In the diagram that I showed where you could you see the coating and the tesserae, the coating was going all along the mortar. It is something that we are working on; we are trying to find a method — and we have not found a solution yet — of applying a coating just to the glass, because it is really the glass that we are trying to protect. Ideally, we hope to leave the surface of the wall breathing, that is to say, by leaving the mortar in between the tesserae not coated. How we are going to do this I don't know. We're testing different types of application of coating, either tessera by tessera or by scratching between the mortar. At the same time, we also did an investigation to see how much moisture is coming from the back of the wall — how much moisture movement we have. And the preliminary results do not seem to indicate a major movement; of course, it is never the case that it is completely dry. So, we want to keep the wall breathing, But it is definitely a very important concern.

Edwards: What kind of coatings are you thinking about? What types of materials?

Piqué: So far we have been trying different types of acrylic. Of course, we have a project, a cycle of maintenance which includes going and removing the coating and applying it again every couple of years. So, we are trying reversible materials. We tried some different types of acrylics; some which are organic modified silicates. We hope to increase the adhesion to the glass because that is one of the problems.

Edwards: I was looking at Paraloid B72 as well, but I was worried about its longterm weathering characteristics.

Piqué: We are doing all the tests; we are testing both *in situ*, and in harder conditions in the labs. So, I think that we will have good results. It is a very interesting aspect, this

one of coating, because for any externally exposed material, this is a problem — how to protect from water and from pollutants.

Melucco Vaccaro: When comparing pictures recording the present poor conditions and the previous ones, you spoke about lack of maintenance. During your research did you collect any evidence about the compatibility of epoxy injections with past interventions?

Piqué: The epoxy injections behind the mosaic seem to be fine. It is interesting that the mosaic itself, the structure is really solid. The major problem of conservation here is really aesthetic, because the corrosion of the surface, so the glass has been corroded away. The epoxy that was used to reapply the gold leaf on the background, that has deteriorated and indeed the gold leaf is falling off again.

Menicou: [trans.] We have the same problem in St. Vitale in Ravenna. We are still undertaking research on it. We have used silica esters which give quite good results allowing the material to breathe, and also in providing a water sealant to protect from water and humidity. We use these materials daily.

Piqué: You use them on the surface of the tesserae for protection? Is this an interior mosaic within a building?

Menicou: [trans.] Yes, we do, but we have very high humidity on the site. We are in a city in which, even inside in internal spaces, the climate is very bad.

Piqué: This problem of corrosion is not a common problem. It is not something that you find at this level elsewhere because this glass is really, really poor, really rich in potassium. We did a small cleaning test two years ago; the glass which was cleaned is now completely corroded again. So it is a really rapid deterioration process that we are looking at.

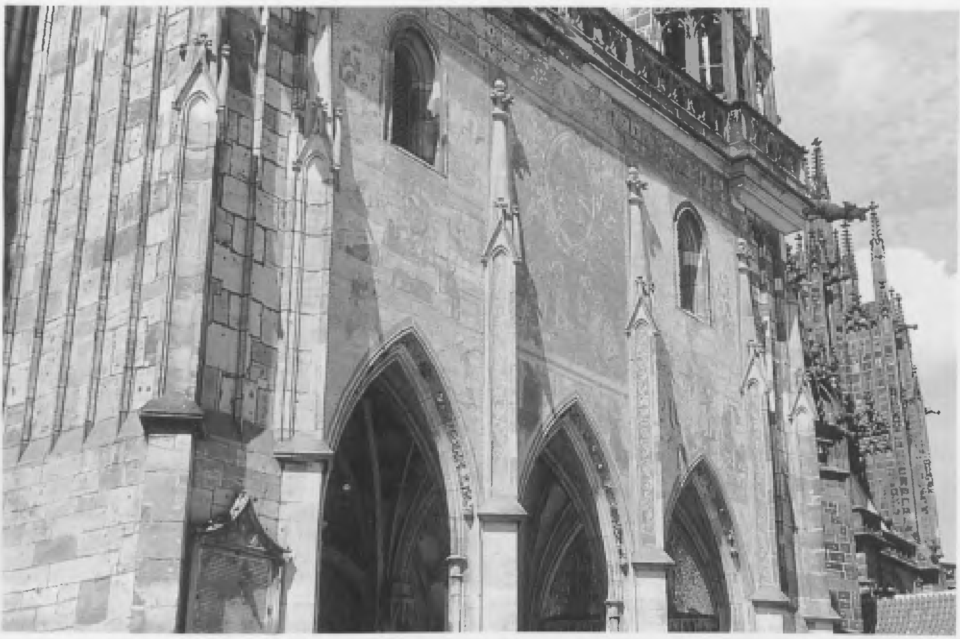


Fig. 1: Last Judgement mosaic. The mosaic is composed of three panels. In the middle section is the figure of Christ sitting in judgment on a rainbow-coloured arch (mandorla) and surrounded by angels. Below Christ is a group of the patron saints of Bohemia. At the bottom of the central section of the mosaic are two wedge-shaped spaces that contain a portrait of Charles IV on one side and on the opposite side, his fourth wife, Elizabeth of Pomerania.



Fig. 2: Section of the mosaic central panel after cleaning showing the coloured glass and the use of natural stones (quartz, opals and chalcedonies), for flesh areas.

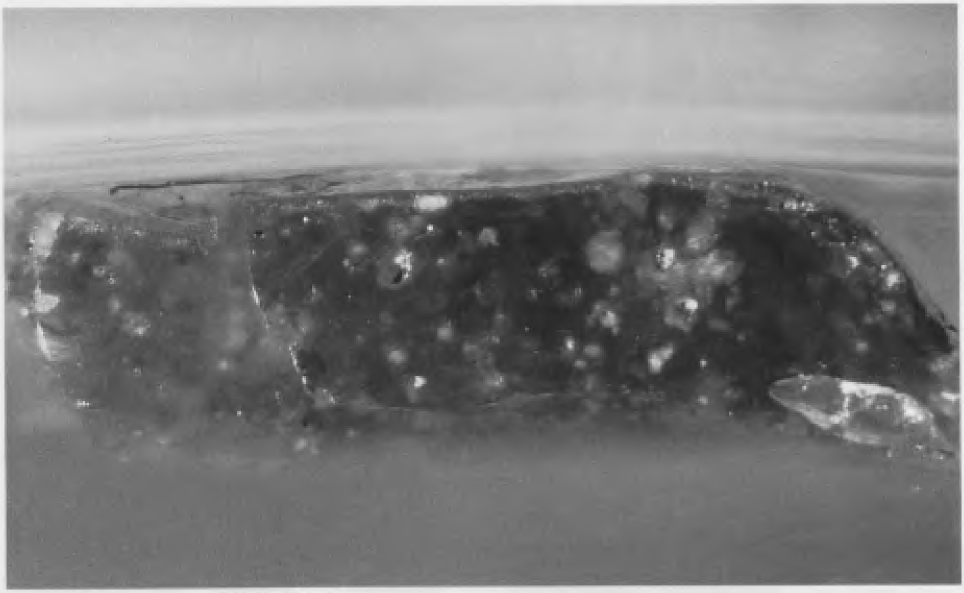




Fig. 3: Close-up of glass tessera cross-section showing the glass' heterogeneity and porosity. Because of its composition and high heterogeneity, this glass is very vulnerable and prone to corrosion.

Fig. 4: Last Judgement mosaic. Central panel after cleaning, before re-gilding. The gold leaf, added in 1910 when the mosaic sections were repositioned, has maintained its gilded appearance. The resulting optical effect is of a gilded grid on a darker background, particularly evident in the central panel.

SESSION 3

DOCUMENTATION OF THE CONDITION OF MOSAICS *IN SITU*

Fig. [illegible] Close-up of [illegible] cross-section, showing the glass heterogeneity and porosity [illegible] of its composition and high [illegible] is very vulnerable and prone [illegible] corrosion.

[illegible] mosaic [illegible] cleaning, before re-gilding. The gold [illegible] added in 1910 when the mosaic [illegible] Repaccioness, has maintained its gilded [illegible]. The resulting optical effect [illegible] on a darker background [illegible] in the restored parts.

Mike Corfield

A framework for the documentation of *in situ* mosaic conservation projects

Conservators and archaeologists have always recognised the fundamental importance of documentation, however there has been a shift in perceptions about the purpose of documentation. A review of a CHIN bibliographic database search under mosaics, conservation, and documentation gave sixty-nine references; of these, a large number were concerned with the iconography and art history of the mosaics, some were about the documentation of the materials, some with the condition of the mosaic, and some with the recording of the treatment applied. There were no references about the mosaic in its context, and none of the abstracts suggested that all these elements of documentation should be brought together into a single integrated archive so that the best conservation could be applied in relation to the mosaic's condition, its situation, the factors affecting its condition and the mosaic's relationship to the site and its interpretation.

In the discussion of this keynote presentation on documentation (see pp. 139-141), Gaël de Guichen suggested that documentation was essentially a management tool, and correctly stressed the importance of documenting the total national mosaic resource so that their conservation could be prioritised. In the same discussion, Roberto Nardi described documentation as being a cultural attitude, the wheel of exchange of information between professionals and between the years and the centuries.

Both these perceptions of documentation are correct. Documentation is a tool, but it is above all the means whereby the whole rationale of an excavation and conservation project is expressed. Documentation is an essential prerequisite of any archaeological or conservation project. Where the intended outcome is the preservation *in situ* of structural or decorative features the quality of information gathered and its organisation into a sensible format is even more important. The information gathered, both during excavation, and during the conservation processes is an essential component of the archaeological archive; it is a fundamental requirement of ethical archaeologists and conservators that they organise the archive in such a way that it can be readily understood by those who may need to use or reinterpret the data gathered. However, it is worth considering the reason for collecting the data and the purpose to which it will be put. There are a number of levels of documentation: at the base level there is the documentation of what has been found, and the conservation that has been applied to it to keep it in a stable state.

Over and above this, there is the documentation that sets out the aims of the project and informs the owner of the objectives of the excavation; there is the documentation that sets out the methodology for the project, and its re-evaluation in the light of what has been found to establish the methodology for the conservation of the site; looking ahead, the documentation should establish the baseline condition of the site so that future changes can be monitored and the effectiveness of the treatments assessed; and finally, the documentation should inform the future management plan of the site. At the completion of the project, the archive should be deposited in the national and local repositories of the country in which the site is located in a conservation-secure state, i.e., using appropriate, conservation-grade materials wherever possible (Walker 1990).

In summary, the purposes of documentation are:

- to inform the owner or responsible authority of the intention of the project;
- to propose the objectives of the project;
- to propose methodologies;
- to record the project;
- to establish the baseline conditions;
- to monitor future changes;
- to assess the effectiveness of treatments;
- to inform the future management plan of the site.

DOCUMENTATION FOR ARCHAEOLOGICAL MOSAICS

Pre-Excavation Documentation

Documentation must begin at the planning stage of any project. Most authorities responsible for the archaeological heritage will require excavators planning to investigate sites to submit their proposals for approval. These proposals should set out the aims of the project clearly and should indicate how the aims will be achieved (Nardi 1996). Where they exist, the proposal should also show how the project fits into the national research objectives of the owner country (e.g. English Heritage 1989). It is extremely important that the excavation strategy should show how any findings made, or any features exposed, during the course of the excavation will be recorded and how they will be cared for during the period between exposure and their eventual investigation and conservation. This will be particularly necessary where structural features are to be preserved *in situ.* Mosaic floors and wall decoration will, during burial, have become part of a hydrogeological system, and on exposure they will become the interface between the ground environment and the atmospheric environment. Any movement of moisture and dissolved salts between these two systems must pass through or around the exposed features, where they are exchanged there is potential for damage to surfaces as salts crystallise out of solution where the air humidity is significantly lower than the ground, and for biological activity where ground and air moisture levels are sufficiently high (Podany *et al.*, 1994). In these

circumstances the documentation should extend to recording the topographical setting of the site, its hydrogeology, and the prevailing climatic conditions as all these may influence the sustainability of any plans for *in situ* conservation.

In all circumstances any project which sets out to preserve mosaics *in situ* will require a careful pre-conservation evaluation; in this, all the factors likely to affect the mosaics should be considered, and the practicality of preservation *in situ* assessed. The possibility that the mosaic cannot be preserved exposed should not be ignored, and if this is the case then the decision has to be either to rebury the mosaic, or to remove it to another location, though this should always be considered the poorer option. Mosaics are an integral part of the building and the site, and to separate them diminishes the public perception of them both. The rationale for removal of a mosaic from its site will need to be persuasively argued and documented. A flowchart for reaching the decision to preserve *in situ*, remove, or backfill a mosaic was offered by Nardi at the 5th ICCM conference (Nardi 1994a).

Proposals for a project which involves the *in situ* conservation of mosaics should include the following information:

- location of the site;
- objectives of the project;
- relationship to national or local research strategies;
- means by which the objectives will be achieved;
- resources to be used on the project;
- timetable for the project;
- methodology for the immediate care of the finds and for preventing the deterioration of the mosaics;
- strategy for the protection of the mosaics until full conservation can be undertaken;
- strategy for the conservation of the mosaics, including an assessment of the sustainability of *in situ* preservation;
- strategy for the long term conservation and management of the mosaics;
- proposals for depositing the excavation archive and the dissemination of the outcome of the project.

Ideally, proposals for projects leading to the preservation *in situ* of mosaics should be developed with full collaboration between the archaeologists and conservators with experience of the special demands of *in situ* preservation. There must also be close consultation with the local authorities who will be responsible for the long term care of the site and for its interpretation to the visiting public; these must be made aware of the maintenance that will be required. Patrick Blanc emphasises the need for co-operation agreements that are true partnerships and take account of local resources and materials, and Roberto Nardi stressed the importance of training local personnel who will be responsible for future maintenance of the site in the proceedings of the 5th ICCM Conference (Nardi 1994b), and does so again elsewhere in these proceedings. Archaeological campaigns by

foreign missions that simply aim to uncover a new mosaic without taking on the attendant responsibilities listed above are irresponsible and a negation of the ethical standards that professional archaeologists should espouse.

Documentation during excavation

Normal archaeological recording will document the stratigraphic sequences and any artefactual or ecofactual evidence above the mosaic. It will also be valuable during excavation to document the soil type and the soil conditions — the soil moisture content, the dissolved salts in the soil and its pH will be especially useful during any subsequent assessment of the likelihood of post-excavation salt efflorescence, or in wetter climates, of microbiological activity. As soon as possible after the floor or wall mosaics are revealed, the process of documentation should be started.

Not surprisingly, there is a long history of mosaic recording. The discovery of such visually significant features by antiquarians presented a rare opportunity to describe an ancient work of art. Early engravings of mosaics found over the past two centuries are often exquisitely drawn and of surprising accuracy. The Roman villa at Bignor (West Sussex, England) was discovered in 1811. Samuel Lysons, a prominent English antiquarian was invited by the owner to supervise the excavations and, assisted by Richard Smirke, an antiquarian draughtsman, he made accurate drawings of the fine mosaics clearly showing the extent of the losses. At Littlecote Roman villa (Berkshire, England) the Orpheus Mosaic, discovered in 1727, was recorded as a tapestry by Mrs George, the wife of the owner! Subsequently, it was drawn by George Vertue, the engraver to the Society of Antiquaries of London (Fig. 1). The rediscovery of this mosaic in 1977 enabled the excavator to reevaluate the accuracy of the tapestry and Vertue's engraving; while there were inaccuracies, there was sufficient detail to allow the mosaic, which had been considerably damaged by tree roots and burrowing animals, to be reconstructed (Walters 1981). Luigi Thompson continued the record of the mosaic with a record of the floor at the time of its latest excavation, and of it in its heavily restored state. This tradition of high quality draughtsmanship for recording mosaics still has a place in modern investigations, the quality of the pen and water-colour drawings by artists such as David Neal are hard to surpass (Neal 1991). Nonetheless, as the basis for conservation documentation drawn records have their deficiencies, not least that in this style of documentation the exact condition of the mosaic is not necessarily represented.

The excavation record should include the site environs and will need to be sufficiently extensive that the effects of topography on climate and ground water movement can be determined. It should also include information about the underlying geology and the nature of the soil. It may be possible to use local mapping information where this is to a large enough scale, but it is more probable that survey will be necessary, particularly where the ground surface is liable to change. Satellite images may be of value to give enhanced information about changes to local conditions, but generally the resolution is not sufficiently high for site specific studies.

A drawn record will need to be to the highest accuracy, and should show the relationship of the mosaics to other structural elements. The exact postion and size of each individual tessera and their colours should be recorded as accurately as possible immediately after exposure. Standard colour recording systems such as Munsell color charts should be used in preference to photographic records which are not sufficiently accurate. The drawing might be augmented by rubbings such as those described by Chlouveraki and Politis (see pp. 151-152); rubbings are rapidly made and will give the exact location and shape of the individual tesserae, though the position of each rubbing within the site will need to be carefully recorded. Care will be needed where there are weaknesses in the bedding of the tesserae, particularly if there are voids between them and the bedding. The topography of the floors should be recorded using standard surveying methods, and where possible all this work should be done without walking on the floor. Elsewhere in these proceedings Nardi describes how a system for working from supported boards was used for the work on the Mosaic of the Nile at Zippori, and a similar system was necessary at Brading Roman Villa.

Photography is an important recording medium, but it is often simply done to augment the drawn record. Accurate vertical photographs can be valuable for detailed recording, and may be used to build up a photomosaic; if there is sufficient overlap of the images the surface topography can be extrapolated by stereoscopic methods. An accurate contour map was created of the mosaic in the Cathdral of Otranto, the process described as "air survey" is unfortunately not described, but presumably a computerised surveying method was used, and from it an axonometric diagram was created (Tomassi 1986).

The most accurate method of recording is by means of a photogrammetric system. In Room 12 at Brading (Figg. 2-3), a precise three dimensional framework was created by means of 120 accurately surveyed points on the floor. Using a Rolei 6006 camera, 104 black and white and colour photographs were taken forming 80 stereopairs. From this survey composite black and white prints were made by cutting and pasting, and these were used as the base for all the condition records. The colour negatives were scanned into a digital photogrammetric work station using a high resolution scanner. The completed digital orthophoto image of the mosaic was generated from the data giving very accurate representations of the mosaic relief. The digitised image can be viewed on the screen three dimensionally using special polarising spectacles, and this gives a remarkable representation of the mosaic, accurate in every detail (Clowes 1997). It is intended that this digitised image should form the base for all subsequent records, and the project team will be exploring with the survey team how the condition and treatment information can be accurately overlaid onto the image. The accuracy of the record will enable the precise registration of all future changes in the mosaic.

Surface condition is only one aspect of mosaic documentation. When mosaics are to be preserved *in situ* it is particularly important to be aware of the nature and condition of the foundation and bedding layers, and of any hypocausting that may survive undisturbed. Traditional tapping methods give a fairly accurate idea of the condition of the bond between the tesserae and the bedding mortar, but ground penetrating radar can

additionally give an indication of the presence of disruptions to the foundations. The data from radar surveys can be difficult to interpret, but it can be an invaluable method for identifying the presence of hypocausting and was used for this purpose at the Chedworth Roman Villa (Gloucestershire England) (John Stewart, pers. comm.). In a recent survey of Brading Roman Villa (Fig. 4) an attempt was made to correlate the defects in the foundation layers with the surface effects and to offer possible mechanisms for the deterioration. It is in some ways gratifying that Edwards' low-tech condition survey, described elsewhere, compared well with the radar survey, but nonetheless, the radar did reveal deep faults in the foundations that could only otherwise have been revealed by lifting and excavation.

Experiments to assess the effectiveness of acoustic surveys of the bond between tesserae and their bedding were described by Bonarrigio and Cucco at the Soria Conference (Bonarrigio and Cucco 1986), and the technique was used to survey the condition of the floor of the Cathedral at Otranto (Tomassi 1986).

The tesserae, being the point of interface between the ground and the air, are especially sensitive and their composition will be an important consideration when considering *in situ* conservation. High quality mosaics were constructed using tesserae made from durable materials — hard stone, ceramic and glass for example and these will form a barrier to the transmission of moisture from the ground to the air; with these materials, salt crystallisation may be expected to occur in the interstices between the tesserea, or where the grouting is in a hard medium, under the tesselated layer. Softer porous materials such as chalk and shale will allow moisture to pass though them and the post excavation deterioration of these due to salt crystallisation within them may be rapid. The nature of the mortar may also affect the durability of the floor to post excavation conditions. Chilouveraki and Politis give the results of such analyses, and of the mortar from their investigations at Deir 'Ain 'Abata and careful documentation of such information will be an essential element of long term conservation regimes.

The ground conditions are a vital consideration for *in situ* conservation. The topography will have a significant influence if, as is often the case in Britain, the villa has been located on the spring line with a hill slope above. Such locations were chosen because they provided a sure source of water, and while this may have been of benefit to the original occupants of the villa, an unregulated water supply today may be highly detrimental. Such was the case at Brading where the current campaign was made necessary by heavy rainfall and a lack of maintenance to the site which allowed groundwater to flood into the villa; the situation here was exacerbated by the location of the villa at the foot of a hill slope. The drainage system described by Edwards appears to have alleviated the situation, but monitoring of the ground resistance has continued as a guide to changes in soil moisture content: it continues to rise as the soil moisture content falls.

Changing groundwater conditions may have more dramatic consequences. The Roman town of Butrint in Albania is being affected because the land mass is sinking resulting in rising sea levels, as the water levels rise so a significant salt problem is being created on the mosaics. Similar problems will have to be faced at sites elsewhere, particularly along the Mediterranean coasts where sea level changes are being most acutely felt and it

is difficult to see what can be done to mitigate the effects other than through a major intervention. In the Nile valley, water levels are rising as a consequence of the construction of the Aswan High Dam, and this is a salutary reminder that effects on archaeological sites can be caused by activities at a far distance.

Careful documentation of water levels at critical sites will be vital if action is to be taken to mitigate the effects of changes at an early stage before the safety of any mosaics is compromised. The mosaics at Fishbourne (Sussex, England) were preserved *in situ* after their excavation; subsequently, because the site is located on low lying ground near to the sea, it suffered from rising damp, salt efflorescence, and occasional flooding. The floors have now been lifted and relaid onto an impervious foundation and Novis (1983) has described how the original contours were preserved by making a mould of the surface. Despite this care to maintain the excavated topography, there are many who feel that they have lost their archaeological context surrounded as they are now by modern mortar. Stubbs (1984) has suggested that the rising damp at Fishbourne could have been mitigated by construction of dry wells into which the ground water would have drained. Weidmann describes a similar procedure for drainage of the perimeter of the site, although in this case the aim is to dry the substrate and vary the rate of humidity changes in it (see pp. 169-174). Such procedures would have to be developed on a grander scale to deal with the extreme rises in water table at sites such as Butrint.

The interaction between the groundwater and the air is an important agent of deterioration of mosaics. The mosaic is the interface between these two systems and it will be affected by the interchange of moisture between them. It is very difficult to prevent evaporation at the surface and such evaporation will deposit any salts that the water may have been carrying. Although salts may be removed from the tesserae and from the immediate substrate more will be transported from the soil to replace those removed. Elsewhere Weidmann explains the recording needed to determine the ground and atmospheric environment of mosaic 9 at Orbe-Boscéaz and discusses how the salt loading of the soil might be reduced, but before the environment can be adapted careful documentation of the prevailing conditions is necessary.

Documentation of past and current interventions

Interventions are the aspect of conservation that is most conscientiously documented by conservators. The manner in which it is done often does not give sufficient consideration to the use that will be made of the documentation in the future. In an intervention on a mosaic, for example, it is unfortunately not always clear what materials have been used at which place on the pavement. In interventions on mosaics, the ideal documentation will be a combination of graphic and written information: a plan of the floor with the areas of intervention marked clearly and differentiated to indicate the use of different techniques and materials, supported by written information or databases that describe exactly the materials that have been used, including formulations for mortars and grouts. There are numerous examples of such documentation and it is not necessary to reiterate them here.

Documentation in planning protective cover buildings

Before shelters for mosaics can be designed, it is essential to gather as comprehensive documentation as is possible about the climatic conditions throughout the year, particularly the temperatures, the hours of sunlight and the fall of sunlight on the site, the prevailing wind, and rainfall. The ground conditions will also be important and records should be made of surface water flows and of the movement of subterranean water; the salts in the water should be determined. All these factors will need to be evaluated in the design of the cover building, and there will need to be some trade off to avoid conditions in the cover building that will encourage salt efflorescence at one extreme or biological activity at the other.

Surface evaporation may be exacerbated by the construction of cover buildings. The mosaics at Bignor have been protected under such a building since 1813, but despite this and despite most of the mosaics being relaid onto a concrete foundation, the mosaics are still subject to salt efflorescence. Fortunately, it does not seem to have had a significant effect on the physical condition of the tesserae. At Brading, efflorescence is similarly a problem but the moisture evaporation and the salt crystallisation occurs preferentially along the lines of the more permeable lias [1] tesserae and here it is adversely affecting them. At Fishbourne, a modern cover building was erected towards the end of the excavations in 1969. Unlike those at Bignor, which are designed like country barns, the Fishbourne building is a modern structure of wood, aluminium and glass and the efflorescence noted above was very probably made worse by solar gain, an inevitable consequence of a structure with so much glazed surface. In such a building, the increased heat level will reduce the relative humidity and encourage evaporation from the soil.

This effect has also been seen in Sicily at the Piazza Amerina where, in the 1950s, possibly the first modern cover building was erected to protect the important mosaics found there. Despite great care being taken to ensure that the structure was well ventilated visitors to the site complain of the high temperatures in the building (Fitch 1982). Nicholas Stanley-Price discusses the problems at this site elsewhere in this volume.

In suitable climates, the tent-like hexashelter used to provide temporary protection to the Orpheus Mosaic at Paphos may be suitable as a means of preventing climatic differences between the outside and the inside of the cover building. At Dorchester (Dorset, England) a new cover building is being erected over a Roman town house at Colliton Park. The design of this tubular steel framed building incorporates considerable overhangs to the roof, which is of wood and stone tiles; the walls are of glass panels which do not butt against the framing but have a wide gap for air movement. Some panels are hinged so that they can be opened to provide additional ventilation. The architect hopes that the overhang of the roof will prevent the sun shining directly through the glass wall panels,

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[1] A pale grey, clayey limestone usually found with clay and shale, commonly in southwest England.

and that the air movement will reduce the surface drying and efflorescence that results from many other cover buildings. Careful documentation of the environment will be necessary to ensure that the desired conditions are being achieved by the cover building.

In these cases, a thorough and continuous recording of the ground and atmospheric conditions is necessary so that temperatures and the associated relative humidity can be balanced against the soil moisture, and measures can be taken to reduce conditions likely to be detrimental to the mosaics. A regime to mitigate the effects of extreme conditions may then be devised that works with the climatic and soil conditions, allowing sustainable and cost effective control of the causes of deterioration. English Heritage have prepared a brief for a feasibility study of the replacement of the cover building at Brading that aims to make use of the building's construction to provide the environment which will prevent the worst of the salt crystallisation and at the same time avoid the high humidities that are conducive to algal growth.

Documentation for managing mosaics

The problems of managing sites where mosaics are preserved *in situ* are considerable. Informed visitors to sites such as Paphos and Kourion can only wonder at the extent of the problems associated with sites where excavation in the past has been almost entirely uncontrolled, and where mosaics of the highest quality are exposed and deteriorating. Some of the issues to be addressed were described by Papageorghiou at the Aquileia Conference (Papageorghiou 1983). Still greater management problems must be addressed in former war zones; the major concerns of the archaeologist responsible for the site of Baalbek in Lebanon are how to control the grass and weeds that are growing on the mosaics, and how to prevent the looting of the site by visitors. The climate in the Bekaa Valley ranges from 40 °C in summer to freezing temperatures in winter. Cover buildings are inappropriate and even protection during the winter months is not feasible on such a scale.

As recently as September 1996 *The Times* of London reported on the deteriorating condition of the mosaics at Pompeii as a consequence of excessive, unmanaged crowds of visitors. Many of the mosaics, it said, are protected under perspex (Plexiglass), and the *cave canem* mosaic has been fenced off to protect it. Prof. Walter Mazzitti, the president of the Archaeological Club of Pompeii is reported as saying that "people trample the mosaics and deface the plaster and Pompeii cannot much longer withstand the 30,000 visitors a day storming *en masse* through the site." The British School in Rome and the superintendent's office were reported to be drawing up a plan for a more rational restoration (*The Times* 1996).

As a follow up to the report on Pompeii, a letter also in the Times expressed concern about the neglect of the mosaics at Empúries on the Costa Brava in Spain. The mosaics here are not protected from the elements, and, in the words of the writer "...the immediate area is strewn with loose fragments." He "...hopes that the mosaic can be restored...before the kleptomaniac tourists have 'swept the floor'." (*The Times* 1996).

It is important that authorities responsible for the managment of major archaeological resources should have all the available information about the mosaics on hand. An enormously useful resource is a rapid survey condition of the mosaics that can support decisions made about devoting limited resources to those most in need of attention. Such a methodology has been widely used in the United Kingdom for surveying museum collections (Keene 1996), and has been applied to the survey at some 60 sites owned by English Heritage where there are wallpaintings present. The basis of the survey is a four point scale which categorises the subject of the survey, which in the case of mosaics may be a whole floor, or it could be sections of the floor according to need. The four categories of condition are:

1. the item is in excellent condition and needs no attention to improve either its state of preservation or its aesthetic condition;
2. the item is in good condition but needs some attention to improve its aesthetic condition;
3. the item is in fair condition but will need some attention within the next five years or so to prevent its condition becoming serious;
4. the item's condition is serious and it must have urgent treatment if it is not to deteriorate to such an extent that it is lost.

This basic information can be repeated for any number of elements such as walls, walkways and cover buildings. The record can be refined to give more detailed information if this is appropriate; for the English Heritage wallpaintings survey, an extensive dossier has been assembled for each site. From all the elements surveyed a prioritised list of conservation needs can be created for the site. It will be necessary to put the list into the context of the art historical and archaeological importance of the mosaic. It would be unwise to take this too far though, otherwise attention will always be directed at the mosaics considered most important, and lesser floors may be neglected. This can be seen at Kourion and Paphos, where clearly the resources are focussed on the most impressive mosaics and sadly many less well preserved floors appear to be simply being allowed to disintegrate.

Management plans are required for all World Heritage Sites, and guidelines have been written setting out the requirements of such plans (Feilden and Jokilehto 1993). The Guidelines emphasise the need for the physical condition and the causes of deterioration to be understood; they further stress that planning is a continual process which must be reviewed at regular intervals, and that "reviews can, if the planning process is scientific and logical, correct mistakes and refine concepts." A management plan is being developed for Paphos; the plan will have to address all the factors affecting the condition of the mosaics which are described in this paper, and particularly it should assess the condition of all the mosaics by a quantitative method which will enable the site managers to allocate resources according to need rather than to enhance the appearance of the great mosaics on the site. Unquestionably the latter need to be cherished because it is for these that many visitors will be drawn to the site, but the site is integrated by the buildings containing geomentric mosaics and some of the figurative mosaics which are currently less well protected than others, and these need urgent attention if they are not to decay beyond recall.

	DATA TYPE	PURPOSE OF DOCUMENTATION	DATA SOURCE
Survey	Graphic	To place site in its context and assess the effects of topography on the mosaic	Contour survey Local mapping Satellite images
Wind, Rainfall, Temperature, evaporation	Graphic/digital	To determine the effects of climate on the mosaic	Local meteorological data Local weather station
Chemistry Surface and sub surface water flows Groundwater levels	Digital	To determine the effects of the local hydrology on the mosaic	Local water management authority Site monitoring
Soil type Hydraulic conductivity	Digital	To determine the rate of flow of water through the soil	Sampling and analysis
Building remains	Graphic	To record the location of structural remains and the location of mosaics in them	Drawn survey EDM Survey Photography Photogrammetry
The mosaics	Graphic/Digital/Documentary	To record the condition of the mosaics	Visual assessment Tapping Survey Radar survey Acoustic Survey
The tesserae	Graphic/Documentary	To record the material types and assess their durability	Visual assessment Analysis Petrology
The mortars	Documentary	To record mortar types and condition	Visual assessment Analysis
The foundations	Graphic/Digital/Documentary	To record nature and condition	Excavation through voids Radar Survey
Soluble salts	Digital/Documentary	To evaluate the need for mitigation of efflorescence	Sampling and Analysis

DOCUMENTATION FOR THE CONSERVATION OF MOSAICS ON AND IN STANDING STRUCTURES

When mosaics are to be conserved *in situ* in or on a standing building, the project proposal will need to set out how the mosaic interacts with the building structure. Much of the deterioration of decorative features on buildings is caused by structural problems of the building, and it is a waste of scarce resources to treat the symptoms of the deterioration if the root cause has not been rectified. The conservation campaign must therefore be preceded by a thorough investigation of the nature of the deterioration. This should include climatic data, the internal environment of the building, and — where a floor mosaic is the subject — the effects of traffic over the floor and the effects of the cleaning regime. As with archaeological mosaics, the mosaic on a building is the interface between the structure and the atmosphere. Unless there is an impermeable barrier between the mosaic and the structure, salts moving from the structure will crystallise at the surface of permeable tesserae where their formation will cause weakening and eventual loss of material. The bedding mortars and grouts may also be affected, with even more disastrous results.

Mosaics that form part of the architectural detail on buildings and monuments are inherently less easy to protect than those on exposed archaeological sites. In such cases it is rarely possible to give any barrier to the elements, and conservation regimes must necessarily take this into account. Just as for archaeological mosaics, the conservation of architectural mosaics must be preceded by a level of documentation that records all details of their extent and condition. Here again, while traditional methods provide an acceptable level of recording, photogrammetry will enable the captive of surface relief and provide an accurate base for the graphic documentation of condition and of treatment applied.

The Albert Memorial in London was erected in 1896 in memory of Queen Victoria's husband, Prince Albert (Fig. 5). The flamboyant monument, designed to represent a medieval reliquary, was decorated among other things with extensive mosaics designed by Clayton and Bell and made up by Salviati in Venice. The mosaics are the largest in area of any north of the Alps and cover the four gables and eight spandrels, and the vault over the statue of Prince Albert. In the preliminary evaluation it was thought that there was poor adhesion between the mosaics and the structure; it was thought that a selenitic mortar containing sulphur compounds had been used. The mortar failed in places, and early in this century repairs were carried out, refixing where necessary with a very strong cementitious mortar. At the same time considerable areas of gilded smalti were replaced, the originals having failed with the loss of the overglaze and the gold leaf. More recently, further change to the supposed selenitic mortar was thought to have occurred when a failure in the rainwater drainage allowed water to accumulate in the vault of the monument.

In 1994, a major conservation programme for the Memorial was initiated. The specification for the work had been prepared in 1988 when it was anticipated the work would have been started; because the condition of the bedding mortar was expected to be very poor it had been proposed that the mosaics should be removed, deficiencies restored, and then remounted using a cementicious mortar.

When work on the mosaics began in 1996 a careful documentation of the mosaics began. The team which had successfully tendered for the work had engaged Cavaliere Giovanni Cucco, a specialist in Salviati's work. Cucco conducted a variant of a tapping survey using a tuning fork (Fig. 6), and was able to identify where the mosaic was well adhered, where there was slight separation from the bedding, and where there was more serious detachment. This information was recorded on drawings of each mosaic panel (Fig. 7). As a result of the survey, Cucco pronounced the mosaics to be in poor condition. Samples of the mortar were taken for analysis but this did not conclusively demonstrate that selenitic mortar had been used. Attempts to remove a panel from one of the spandrels showed that the mosaics adhered strongly to the monument, and that they were affixed to stonework, which has deep horizontal sawtooth cuts to act as a keying. Because the physical evidence differed from Cucco's survey it was decided to undertake a thermography survey to determine the extent of debonding, the results however were inconclusive. A further option might have been to use acoustic survey (Bonnarigio and Cucco 1986).

Further analysis of the mortar was undertaken, this time with careful documentation of the exact location of the samples. This showed that the original mortar was not selenitic, but rather that a thin layer of mortar immediately behind the tesserae had been converted to gypsum. This had presumably been caused by sulphurous pollution from traffic and fossil fuel burning penetrating the ungrouted mosaic and reacting with the calcium carbonate of the mortar.

At this point the overall strategy was changed and it was agreed that the mosaics should be conserved *in situ.* The changes were made necessary because the initial documentation that preceded the specification was based on inadequate investigation.

Francesca Piqué has shown how careful documentation of the Last Judgement mosaic in Prague has made it possible to define an appropriate conservation regime which should avoid the further loss of material from the tesserae and the need for repeated conservation. Evaluations of the condition of mosaics and of the underlying causes of their deterioration can be lengthy and expensive projects in their own right. However, it is unwise to skimp on the resources for evaluations, for without the detailed knowledge of the condition of the mosaic and how it reacts with the structure and the environment, a proper conservation plan cannot be formulated.

All the documentation and information gathered and created in the course of *in situ* conservation of mosaics must be organised in a manner that enables its correlation and use by those concerned. Exactly how this is done will vary from project to project, and according to circumstances and the media used to record the information, but when there is a substantial amount of electronic data, and especially when there are digital images, a form of graphic-based documentation will often be the most appropriate method. Paper-based documentation must be keyed to accurate, three-dimensional plans of the site and its surroundings, with overlays of information that can be brought together so that interactions, or causes and effects can be deterrmined. Major conservation projects generate extensive documentation and increasingly, only the data-handling capacity of a computer and CAD package or similar spatial referencing system can enable full interpretation of the data. The development of set of standards and guidelines for such documentation is urgently needed in the field, and should be addressed at the ealiest possible opportunity.

ACKNOWLEDGEMENTS

I must acknowledge my personal limitations, and express my thanks to Margaret MacLean and Demetrios Michaelides for giving me the opportunity to express thoughts I have been developing about the documentation of major conservation projects in the context of mosaic conservation. I must give particular thanks to Carol Edwards for many valuable conversations about the conservation of mosaics generally and of those at Brading Roman Villa. Trevor Caley and Gary Bricknell generously allowed me to use their documentation of the Albert Memorial mosaics, and Paul Bryan and Mick Clowes achieved wonders with the photogrammetric survey of the mosaic at Brading.

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DISCUSSION

MacLean: This was a rich presentation of points. Just to review a couple and to get us thinking about policy changes, it might be appropriate in our own countries to support the presence of a conservator on the site, or on a project; as you say, English Heritage has now insisted upon this. All of us can probably serve some purpose in that area. Also the importance of recording context and the difference between an artist's rendering and a specific record, that is, the art historical record versus the condition record. And the organization of the information after the fact, which is, I think, a challenge for all of us. And the concern of the expense of photogrammetry as opposed to perhaps another method that might be used in substitution. Recording of the context and the effects of exposure will help in the design of better cover buildings or shelters. And a wise application of modern technology, that is, knowing when such technology will be useful and when more traditional means will be sufficient. These and other points, I am sure, come to mind.

Stewart: I would like to comment first of all, just in general, on non-destructive surveying techniques, which you have certainly touched upon. And secondly on ground-penetrating radar in particular, which we have also used. Regarding non-destructive technologies, I think that there is a great deal of new technology that has been used within the field of civil engineering and architectural conservation, in fact, for determination of structural condition of features in a non-destructive manner. And I have yet to see a lot of these technologies used to any great extent in mosaics conservation. So I think that the use that you have described is perhaps a good model for us to follow. Secondly, regarding groundpenetrating radar, in particular, we have used it at Chedworth in a very complementary way to your experience at Brading in which your mosaic has been placed on a conventional substrate — that is, a solid substrate — where we have used it on a hypocaust. In other words, if a mosaic is built over a variable substrate with solids and voids, this could be a very effective way to determine structural conditions below the mosaic. But I should say that, as with any of these new technologies, they are subject to interference from unknown features within the structure, and therefore rely upon a great deal of professional interpretation. And this is where the dialogue between the conservator and the specialist is really critical in the interpretation of the data.

Corfield: I would like to support you in that. You really must have that dialogue with the person doing the survey to tell him of the sort of conditions that you expect will be present on the site.

Lavagne: [trans.] I would like to stress one of the major aspects of Mr. Corfield's presentation, which was the vital connection between the various restoration operations which have taken place when you are using the same workshop. I think of Salviati, for example, where you showed Prince Albert's memorial. And you are quite right to call on the people from Venice who did the work on mosaics restored by Salviati at San Marco. But we are forgetting that other types of experiments have

been carried out to restore or de-restore certain mosaics, and the documentation exists. And in fact from that standpoint, the newsletter from our committee could be used for this purpose; in other words, before beginning any restoration or conservation campaign for a mosaic that has been dealt with, for example, by someone in the 17th century, you mention this in the newsletter and you ask if other conservators have had experience of this. We could save a lot of very precious time that way.

MacLean: Those of you in charge of the ICCM bulletin might take note of that.

Palumbo: With the widespread use of computers and increasing computer literacy of the users, I think that the use of computers for mosaic recording will increase in the future. We can think of a mosaic in the way of a digital image, with each tessera being one pixel. It is a way of looking at them. However, to ask a technical question, I was wondering how you can work with a CAD system using digital images. CAD packages cannot always handle digital images and special vector systems in a very useful way. So, I was wondering whether you were thinking about using a geographic information system for that purpose. As you know, GIS being a geographical oriented system, it could, I think, apply very well to a mosaic, being a geographically oriented area.

Corfield: We are looking at geographic information systems just at the moment, and I agree they do have enormous potential. We have not yet applied them to one of the projects that we are dealing with; they are being used for wider archaeological projects. But as you say, they do give you the potential to focus from the macro scale right down to the micro scale and pick out whichever feature, whichever scale you want to look at. And I think this is a valuable tool for the future.

Kakoulli: I would like to make two comments. One is that our keynote speaker spoke extensively about environmental survey prior to the conservation of the mosaic. I think this is of primary importance, and there should be a separate section in such conferences devoted to geophysics and soil studies. These provide valuable information which might obviate some conservation intervention, and they would help in the future conservation of the monument. Concerning documentation, it is excellent to try to improve documentation and use photogrammetry and other parameters that will result in a very accurate condition survey that you can present graphically. But we have to consider that most people do not have access to equipment like that, and they have to deal with simple drawings which, if done professionally, in my own very limited experience, can be of great help. I think we should stress to people who do not have access to the equipment, that they can still undertake very good documentation. It does not matter, for example, if you document a void in a mosaic and it is not located accurately, but it is half a centimetre to the right; when you go there, you will see where the problem is. I think simple documentation will still help in providing a mapping of the problems so you know what you are dealing with. It does not really have to be so accurate.

Corfield: Yes, I would agree with that, and it would be totally wrong to assume that modern technology is the answer to everything. My case for using modern technology where we are able to is that it does allow us to bring together diverse bits of information onto the same screen, onto the same print of information, so that we can perhaps see factors that we might not necessarily consider if they had happened to be in a volume over there and a volume over there and a plan over there. They come together in a much clearer way. But I would also agree that environmental factors and ground factors are absolutely vital; the mosaic has become part of the ground environment, and you must respect that ground environment if you are going to be considering its conservation.

MacLean: I very much appreciate the intervention of Ms. Kakoulli. One of the points I think that came up several times yesterday that was of concern was the difference between seeing the ideal situation, the ideal conservation context and something perhaps less well funded and less elaborate; there has to be some middle ground and we have to look more carefully at defining what the options are. I fully agree that one does not need to go all the way up to remote sensing or very elaborate on-site digital recording in order to achieve adequate documentation. I think it is important that if you cannot do that, that you do not give up entirely on documentation. It is really quite critical. I think that first teaching your students to draw a site is an enormously useful thing; I am sure all of you have done this. There is nothing that trains the eye and the mind better in analytical ways than to force people to sit and to look at something until it begins to speak or make sense or you begin to see patterns that emerge. But in the realm of the middle ground, I think there are a number of techniques such as simplified photogrammetry and single-camera stereo photographs that can be employed. Perhaps there is not enough information out there. Perhaps there is not enough guidance in the literature about how to employ those very simple, straightforward techniques that require very basic technology.

de Guichen: [trans.] Documentation is a tool. It is not documentation for documentation's sake. The first point is that it is essentially a management tool; then it becomes a tool used for intervention. But basically it is a management tool. If you do not know the entire national mosaic situation, and if you do not know how many pavements you have in a nation or where they are, you cannot manage mosaics. We heard an extremely interesting paper with outstanding presentation with high-tech instruments. We can see that we can go much further. But before that, what is missing is more macro documentation on the total national mosaic heritage. We are always talking about sensitizing the authorities. If you want to sensitize the public, there are thousands, or tens of thousands of square metres of mosaics in the country, it will be different. And then we can really begin planning. Then we get down to site documentation, and documentation element by element. It can cost a lot of money, as we have seen; it will require very high-tech instruments, which will get higher and higher tech. But overall documentation of the mosaic heritage in the country does not require very sophisticated instrumentation; it just requires a bit of research,

and then you do not even need a pocket calculator. You can add it up on your fingers and thumbs. At the last conference, it was asked that this effort be made, if it cannot be done at national level, at least that it could be done for all major sites. We do not know how many square metres of mosaics there are in Pompeii; we do not know how many there are in Ostia, unfortunately. Studies of this sort must be carried out. I would like to give an example. Since the last conference, there has only been one example of this sort of research; this is in north Sardinia, where they have done a macro study, and they have come up with the result that they have dug so many thousand square metres. We know this from excavation reports. Today, we find that only forty percent of the mosaics remain; we do not know what has happened to the others. Maybe they have been reburied. So many have been reburied; so many have been lifted and taken to museums; so many percent have been remounted in the museums, and so many have been left *in situ.* But until we have an overview of that sort, I think we should slow down high-tech mosaic technology, just looking at one site or one mosaic.

Corfield: Just a very brief response. That I think was the reason behind our audit of wall paintings. It was to provide us with a very simple means of assessing what we had, because we did not even know how many wall paintings we had, and to provide a very simple method for assessing their condition. It simply places on record what you have got, and I do agree that that is a most important thing.

Ben Abed: I would like to ask Margaret MacLean to say a few words about a project, of which she was recently in charge, on the documentation of mosaics in the Bardo Museum; it is a Getty/Tunisia project which is coming up with extremely promising results of major importance and which will certainly help us to save a certain number of mosaics. I don't think I can let this opportunity go by without Margaret saying a few words about this to our colleagues.

MacLean: The project that the Getty undertook with the staff of the Musée de Bardo in Tunis is just finishing. It is an effort to assist the staff of the museum in developing criteria for judging the condition of this extraordinary collection of mosaics that have been brought together from Roman and other sites all over Tunisia. They felt greatly handicapped by the fact that many experts, or so-called experts, come through the museum in Tunis variously telling them that their mosaics were in beautiful or terrible condition and that they should or should not travel. They were seeking a methodology that they could use to examine and to assess the condition of these remarkable pavements. We have undertaken a limited photographic project of large-format, very basic, wonderful images that will be used as the basis for condition reporting of also a limited but representative set of these pavements. We have finished with the photographing of 33 mosaic pavements, some as big as this room and others smaller, fortunately. The next step will be to work with the staff to develop an approach to condition reporting and an assessment over time and management and maintenance of this collection, that they can easily carry forward with the level of

training that is available and which would be enhanced by a higher level of training, if that were to become available. That is the project. It is a real pleasure to work at the Bardo Museum. It is an amazing collection, and it has, I hope, a great deal to do with the ongoing activity that the Institute will undertake in this mosaics initiative that Miguel Angel Corzo announced the other day.

Nardi: I should like to say that I do not agree with what Gaël (de Guichen) said, that documentation is not a tool; I think documentation is much more. It is a cultural attitude. It is the wheel of exchange of information between professionals and between years and centuries. So, when you fix this point, when you fix the point that you want to transfer to the future what you find and what you do, up to that, any techniques, if it works, works. Concerning the high-tech, I think the high-tech is necessary, it is required when no other means can work. One of the most common questions that we receive when we are in the field is, "Why do you use your hand to tap on the mosaic when there are special sensors?" Because it works. The special sensors are expensive, they need maintenance and electricity, and they make people crazy. So this works. And the first time we tried to use portable computers for documentation on the site, the result was nervous breakdowns! Because of the dust we were changing personal computers every two months, and then we asked ourselves why we were using computers if paper and pencil worked. When you are in the studio you can do what you want, but in the field keep your feet on the ground.

MacLean: That is very good advice and a very optimistic note on which we might conclude this part of the session.

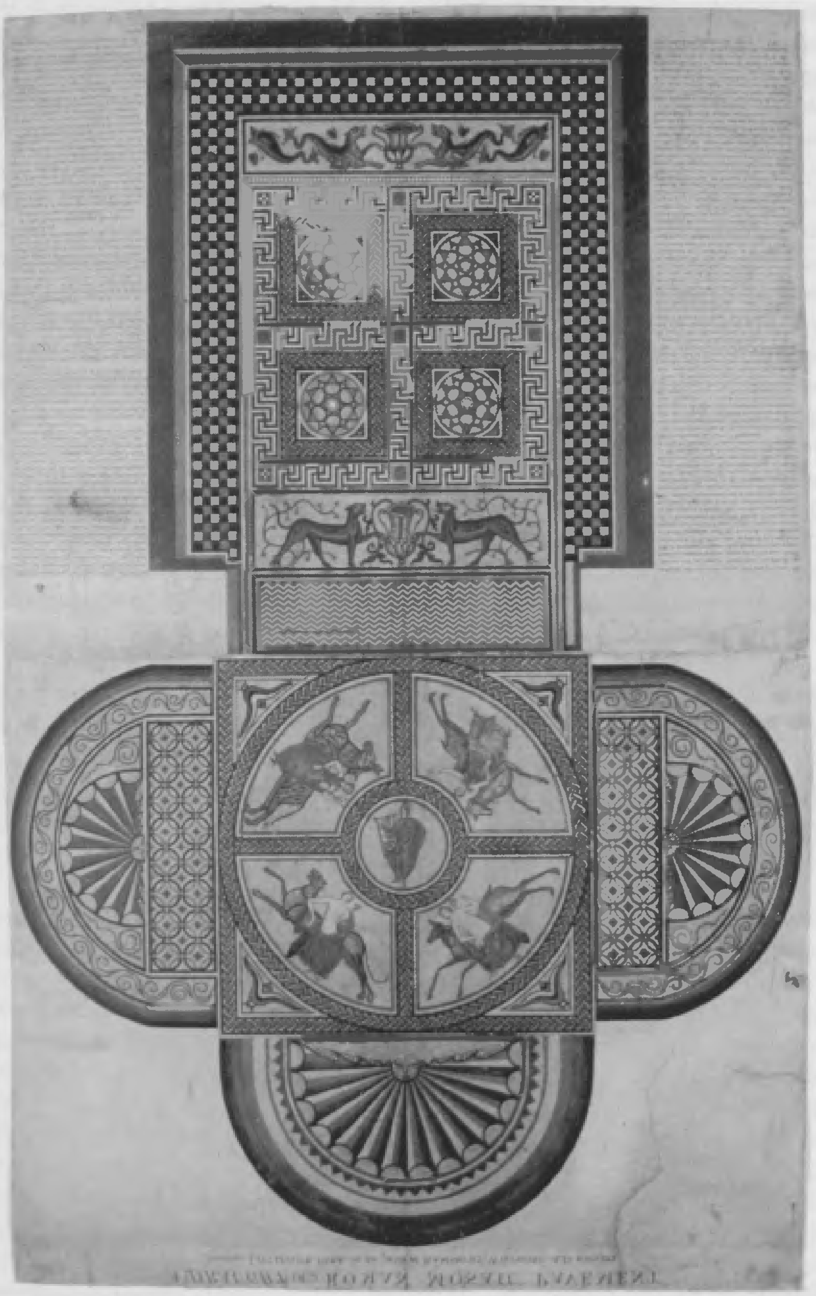


Fig. 1: Vertue's engraving of the Littlecote Orpheus mosaic, 1728. Reproduced by courtesy of the Society of Antiquaries of London.



Fig. 2: Photomosaic of the mosaic in Room 12, Brading Roman Villa (photo by English Heritage Photogrammetric Services).

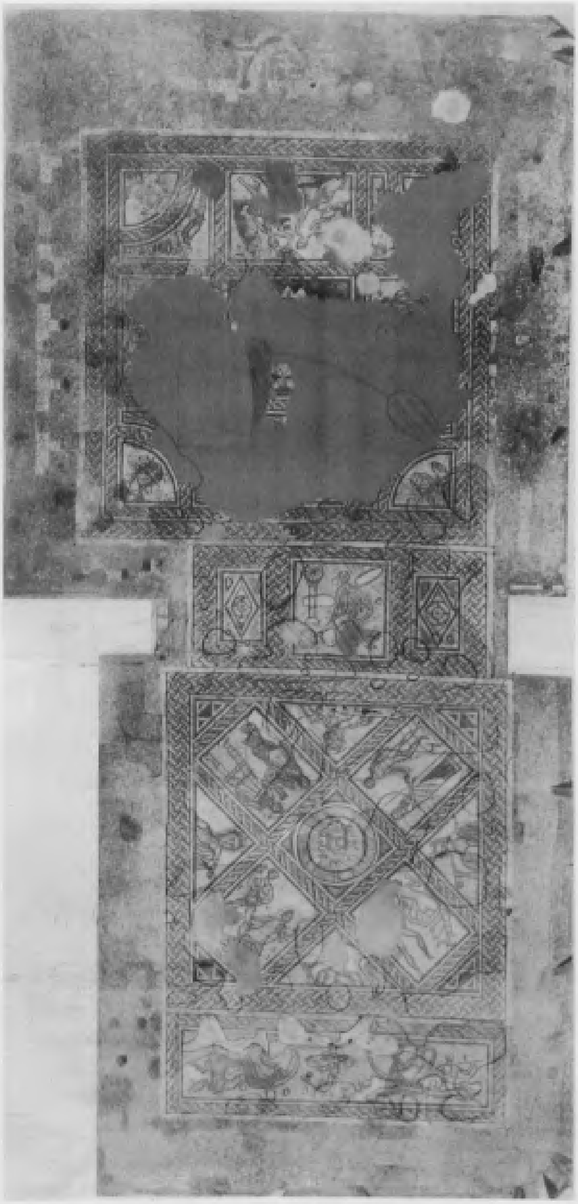


Fig. 3: Condition survey of the Brading Roman Villa overlaid onto a black and white photomosaic. The survey shows areas of detachment outlined in red, and the areas of algal growth in green. Photogrammetric survey by English Heritage, Condition Survey by Carol Edwards, Southern Archaeology, Chichester, West Sussex.

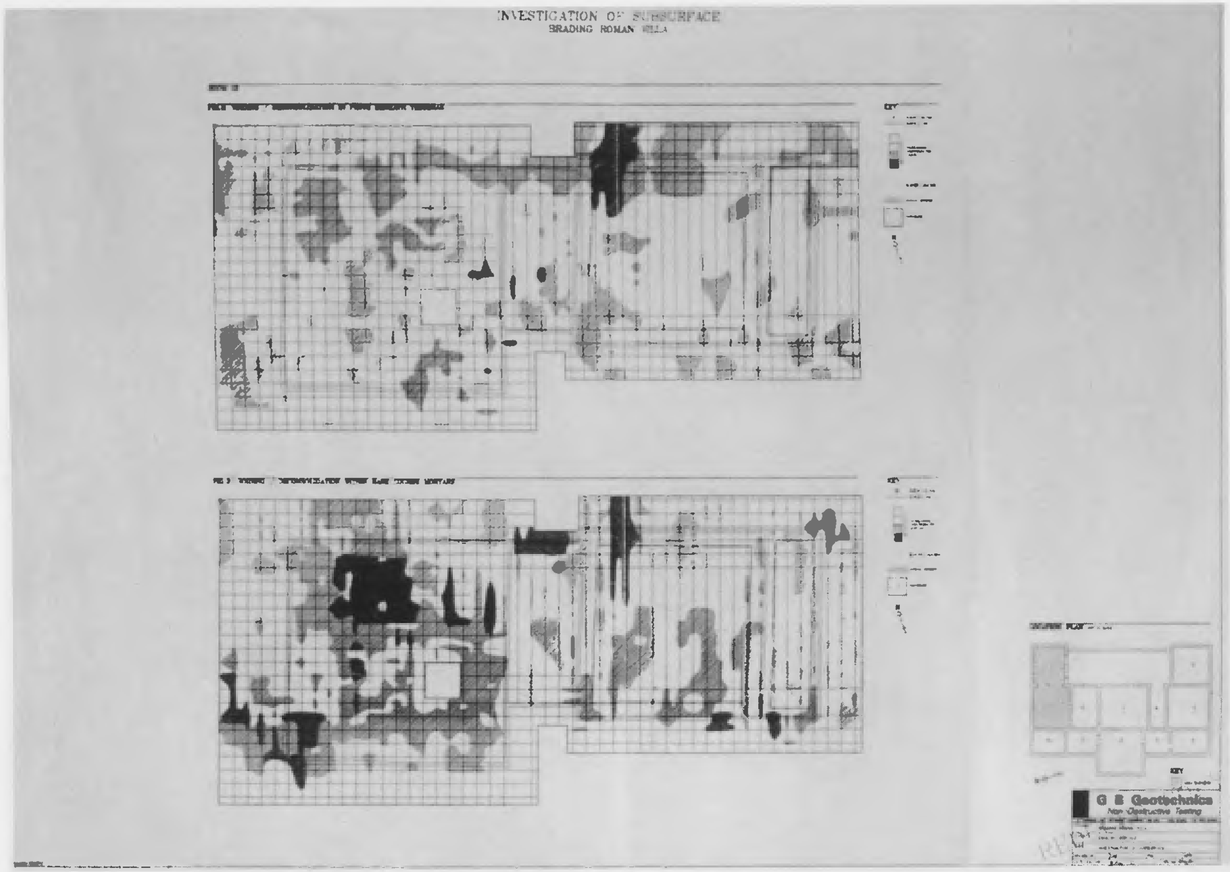


Fig. 4: Radar survey of Room 12, Brading Roman Villa. Two levels of depth are shown: in the upper image the delamination between the tesserae and the bedding is shown, and in the lower image, the areas of weakness in the foundation layers; the darker areas are those of greatest voiding. Survey by Geotechnics, Cambridge, UK.



Fig. 5: The Albert Memorial before conservation. The mosaics are set in each of the four gables, the eight spandrels and the vault over the statue of Prince Albert (photo by English Heritage).



Fig. 6: Giovanni Cucco surveying the mosaic depicting Architecture which is on the north gable. A tuning fork and stethoscope are used to locate the areas of detachment (photo by English Heritage).

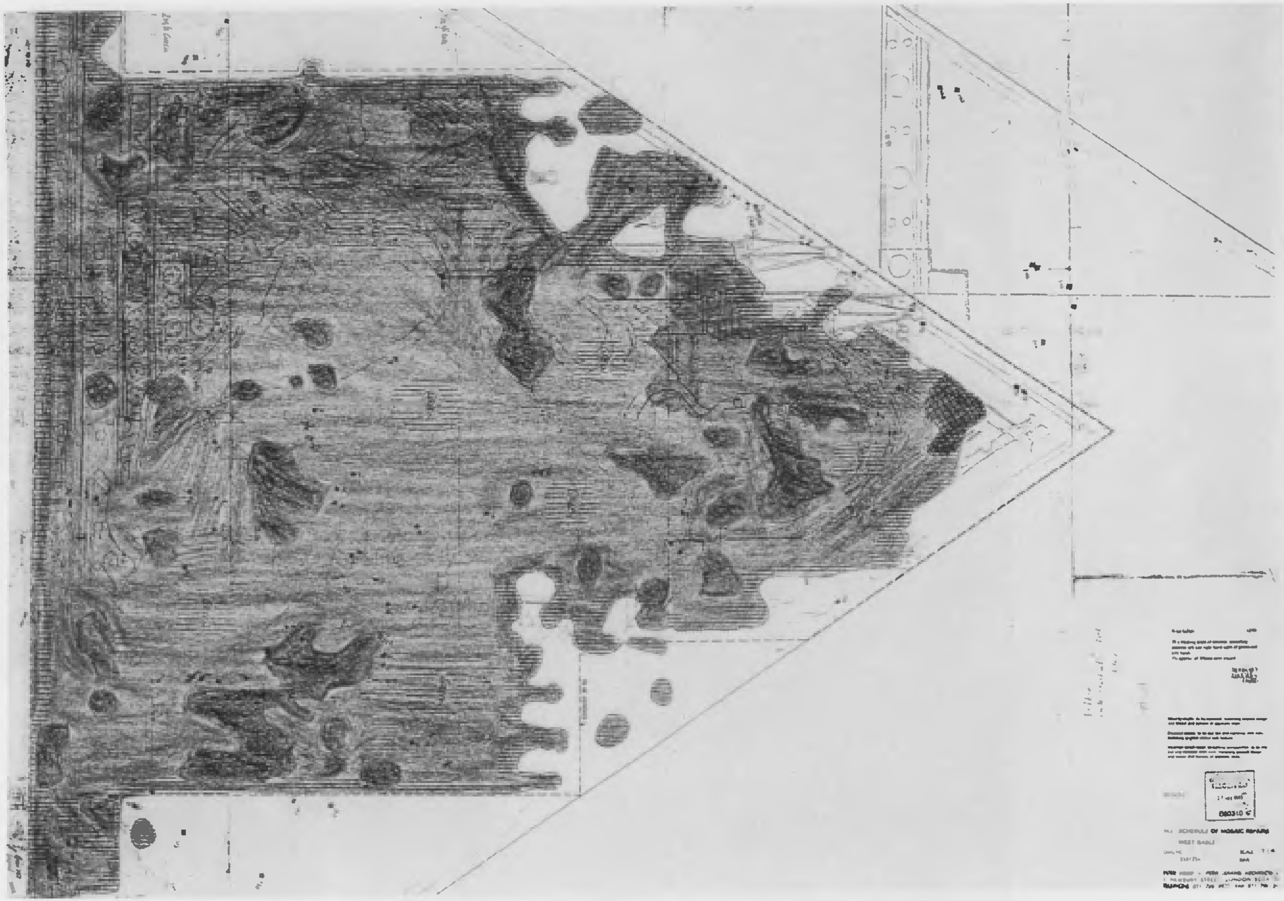


Fig. 7: Graphic documentation of the mosaics on the north gable showing three levels of detachment: green — slight detachment, blue — moderate detachment, red — severe detachment.

Stephania N. Chlouveraki and Konstantinos D. Politis

The documentation and conservation of the nave mosaic in the basilica of Agios Lot at Deir ʿAin ʿAbata, Jordan

INTRODUCTION

The Monastery of Agios Lot is situated in the southern Jordan Rift Valley next to the Byzantine city of Zoara (modern Safi). It overlooks the southern end of the Dead Sea and is built on a 30° scree slope, a Pre-Cambrian conglomerate formation. This formation is at least 250 m thick and consists of thickly embedded, poorly sorted, rounded conglomerate. It is bound with a grey-green matrix of arkosic sandstone. The slope is well cemented and stable in some places, while elsewhere it is loose. Therefore access to the site and the transport of heavy equipment and materials is difficult.

Although the local inhabitants were aware of the ancient ruins, Burton MacDonald was the first to document the site during his survey of the area in 1986. Two years later excavations were begun at Deir ʿAin ʿAbata by an international team of archaeologists under the direction of Konstantinos Politis with the support of the British Museum. During seven seasons of excavations an early Byzantine monastic complex was unearthed, which was identified as the Sanctuary of Agios Lot depicted on the famous mosaic floor map at Madaba in Jordan.

A triple-apsed basilical church was the central feature of the monastery. The building was particularly well-preserved on the eastern mountainside, where it stands to a height of over 3 m where the vaulted roof began. On the western cliff edge side only the foundation walls survive. Three separate mosaic floor pavements were uncovered in the basilica which were adorned by geometric, floral and animal depictions. Each one has a Byzantine Greek inscription.

A policy was developed by the director of the project in conjunction with the site conservators to preserve the mosaic floor pavements *in situ* when possible. In order to protect them properly from future deterioration, preventive conservation and *in situ* interventions needed to be made. Since conservators were directly involved in excavating the mosaics, rescue stabilization could be undertaken immediately.

From 1993, the Ministry of Tourism and Antiquities of Jordan began supporting restorations of the site. The construction of a road and a paved pathway made the site more accessible and facilitated further conservation and restoration work. After a special fund-raising concert held in Bologna that year, some funds were also available specifically for mosaic conservation.

CONDITION OF THE MOSAICS

The state of preservation of the bedding and the tesserae of the three mosaic pavements varies greatly. Different treatment was therefore adopted for each mosaic according to its condition. The aisle and chancel mosaic pavements were left *in situ*. The nave mosaic though, which lies at the edge of the site, was in an extremely vulnerable position and could not be protected effectively by *in situ* interventions. So in 1994 the nave mosaic was lifted with the intention of resetting it after a shelter was constructed over the church.

The extant nave mosaic pavement, representing two thirds of the original, covers approximately 20 m^2. The main decoration is a floral design reminiscent of Nabataean painted pottery styles. A striped animal figure can also be distinguished, along with traces of a second one. An inscription six lines long is located in a frame in the centre of the defined area. It lists names of church officials and dignitaries and is dated to Xanthikos (roughly May) 691 AD.

The subsidence of the foundation bulk fill had resulted in the distortion of the mosaic pavement. The floor had settled about 30 cm below its original level except for the central section and the northern and eastern edges which were supported by intact foundation arches. As a result, the settled areas had been severed from the rest of the mosaic. Large cracks had formed, and consequently tesserae were being dislodged from the edges of these cracks at an alarming rate. Due to the fracturing and weakening of the bedding caused by subsidence movement, the *in situ* tesserae were coming loose. Although consolidation work had been carried out during previous seasons' work, it was not enough to prevent further loss of tesserae.

The tesserae themselves were actually in good condition owing to their hardness and low porosity. It should be mentioned here that the climate of the Dead Sea area is extremely arid. Therefore, despite the high salinity of the environment, its low water content does not induce frequent crystallization cycles.

The location of the nave mosaic, eroding off the cliff's edge, meant that the only north-south passageway was over it. The mosaic had been exposed during each excavation season and was often trodden on by visitors and workmen! This important factor, along with the pavement's poor state of preservation and its awkward distortion, were the decisive reasons that led to the lifting of the nave mosaic.

LIFTING METHOD

Due to the undulation of the mosaic and difficult access to the site, rolling the mosaic pavement was unfeasible. The best solution was to lift it in 22 sections employing the 'puzzle technique' (Fig. 1). The pieces were sectioned by removing a line of tesserae around each fragment. First they were faced with a layer of fine cotton gauze and then with medium-weight linen for extra strength. An 'animal glue' mixture of honey, ox gall, vinegar and water was employed as the adhesive. This glue has been widely used over the last decades for lifting mosaics and its properties have been reported by several authorities. It was chosen because of its flexibility, reversibility, good mechanical properties, non-toxi-

city and low cost. In addition, the arid climate of the site facilitated preservation and stability of the adhesive during storage. The major drawback was that it attracted numerous flies during the lifting process.

Apart from the tessellatum, a section of mortar north-west of the mosaic (section 23) was also faced and lifted. Although the mortar was cracked and therefore very fragile, the impressions of the lost tesserae were preserved, revealing the continuation of the floral design and the existence of a second animal figure. If this is relaid along with the mosaic pavement, it could be lightly painted to indicate the missing design.

The discovery of several well-preserved mosaicists' foot-prints in the third layer of mortar under the mosaic pavement was a great surprise (Fig. 2). The layer they were in lay directly on the rubble hard core and it had apparently been trodden on thoroughly with bare feet in order to settle it into the interstices between the cobbles before the next layer was applied. The foot-prints were photographed, drawn and the best-preserved section measuring 50 x 50 cm was lifted after consolidation.

In the process of lifting the nave mosaic, the septagonal ambon base had to be dismantled. Its consequent removal revealed a section of an earlier mosaic floor (contemporary with the April 606 AD north aisle pavement) concealed underneath, which survived in the shape of the ambon base. It was decided to lift this mosaic in two sections, since it could never be visible in any future restorations of the nave and ambon.

DOCUMENTATION

The condition of the mosaic pavement and the lifting process was fully documented through written records by conservators and archaeologists, photography, drawings based on EDM readings, 1:1 tracings and systematic sampling of materials used in mosaic and bedding construction (Fig. 3).

Aerial photographs of the site were taken in 1993 prior to any conservation or restoration work (Fig. 4). Photographs at right angles to the mosaic with overlapping sections were also taken in order to give a more accurate record of the original pavement. A tracing of the mosaic, tessera by tessera, was made on permatrace paper immediately after excavation, which provided evidence for the lost tesserae in the following years. A second tracing was prepared before lifting, which included the outline of the mosaic and the basic elements of the decoration, the ancient and modern repairs, the damages occurring on the surface and the cut lines and sections which were to be lifted.

The Byzantine Greek inscription on the mosaic was transcribed and studied by an epigrapher before any conservation work was done on it.

A preliminary petrological study was undertaken on the samples of construction materials used for the mosaic pavement. In the course of recording the construction technique of the mosaic and the information under it, each layer of mortar was cleaned, photographed and removed separately. The binding material of all these layers is lime and the aggregate is made up of sand, ceramic and gravel with charcoal inclusions. From a visual analysis of the mortar and from chemical tests in the field with HCl, the following successive layers were distinguished (Fig. 5):

A) Tesselatum, 1.5-2 cm thick. According to a preliminary petrographic study of thin sections, five different types of stone have been employed: black micritic limestone; red ferruginous micritic limestone; yellow limestone; greyish-cream dolomite; and white marble (found only in the stripes of the animal figure).
B) Fine white lime mortar, 2 cm thick with a small amount of fine aggregates in which the tesselatum is set.
C) Grey lime-based mortar with coarse aggregates consisting of sand and ceramic sherds mixed gravel with charcoal inclusions. Debitage from tesserae-cutting have also been used instead of *c.*3 cm sized gravel. This second layer is 2.5-3 cm thick.
D) Grey lime mortar with finer aggregates and the same gravel, 2.5-3 cm thick.
E) Rubble hard core made up of fist-sized rounded cobbles, 7-8 cm thick.
F) Red silt, 10-11 cm thick.
G) Parallel rows of stones and wooden beam remnants existed under the mosaic floor, presumably for creating a pavement above the arches on which the mosaic could be laid (the deterioration of this construction may have been one of the main causes of the subsidence).

A comparative study of the technology and materials used on the mosaic pavement will give us valuable new information about the construction of the basilica.

CONCLUSION

During the documentation of all the mosaic pavements in the basilica, it was observed that their beddings consisted of similar materials as those in the nave. The layers, however, differ in thickness, size of aggregates, ratio of binder-aggregate, density and porosity. It is therefore possible to determine which are contemporary by studying certain characteristics of both mortars and tesserae.

The lifting and resetting of the nave mosaic, as well as the *in situ* conservation of the other pavements, were developed within a framework of the evolution of the project from simply an archaeological excavation to an important tourist attraction. This includes the construction of a mosaic shelter, a protective wall above the entire site, a drainage system, a road with a car park, a paved walkway from the car park to the monastery and a site museum.

At present, the nave mosaic has been stored in a stable and controlled environment. The mosaics left *in situ* have been temporarily buried. The exposed foundation walls were consolidated with lime mortar and rebuilt on the western down slope side of the basilica. A 1.5 m high fence now completely encloses all the mosaic pavements in the church and makes them inaccessible without special reason. The conglomerate slope above the site has been cleared of any loose stones in order to protect the ancient ruins, as well as people below. The long protective wall with an adjacent water channel above the entire site is now almost complete. Plans have also been made to construct a shelter over the

basilical church which would protect all the mosaic pavements as well as the building itself.

It would be ideal to construct this shelter and relay the mosaic pavement removed from the nave. The Department of Antiquities of Jordan is protecting the site and would like to see the project completed. Unfortunately though, funding for this final phase is not yet secured.

ACKNOWLEDGEMENTS

The authors of this paper would like to show their appreciation to the Ministry of Tourism and Antiquities of Jordan and the British Museum for sponsoring the Deir ʿAin ʿAbata restoration project. Thanks are due to Mario Dradi and company of Bologna, Italy for supporting most of the lifting of the nave mosaic in 1994.

The expert surveys of W. Eddie Moth and Thomas Muir and the professional photography of Jim Rossitter and Trevor Springett were invaluable to the work. Professors D. Chryssopoulos and D. Vaphiades of T.E.I., Athens provided beneficial advice on methodology and technical matters.

Finally we must express our greatest gratitude to Olympia Theophanopoulou, Dean Sully, Theodoros Loukeris, Theoni Demitropoulou and Val Munday, who painstakingly climbed up the mountain with us each day to battle heat, dust and, above all, flies in order to conserve the beautiful mosaic floors of St Lot's basilica.

DISCUSSION

For discussion of this paper see after the paper by D. Weidmann.



Fig. 1: The mosaic pavement in the nave of the church during preparation for lifting (photo by J. Rossitter).

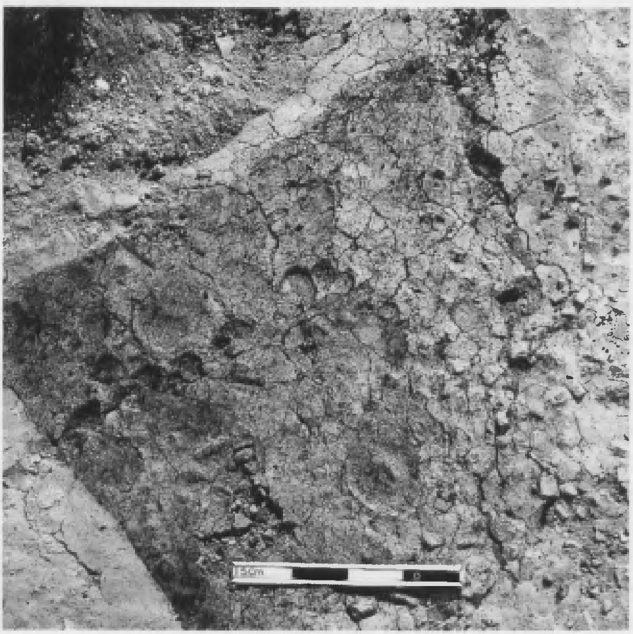


Fig. 2: Footprints embedded in the mortar of the bedding of the nave mosaic pavement (photo by J. Rossitter).

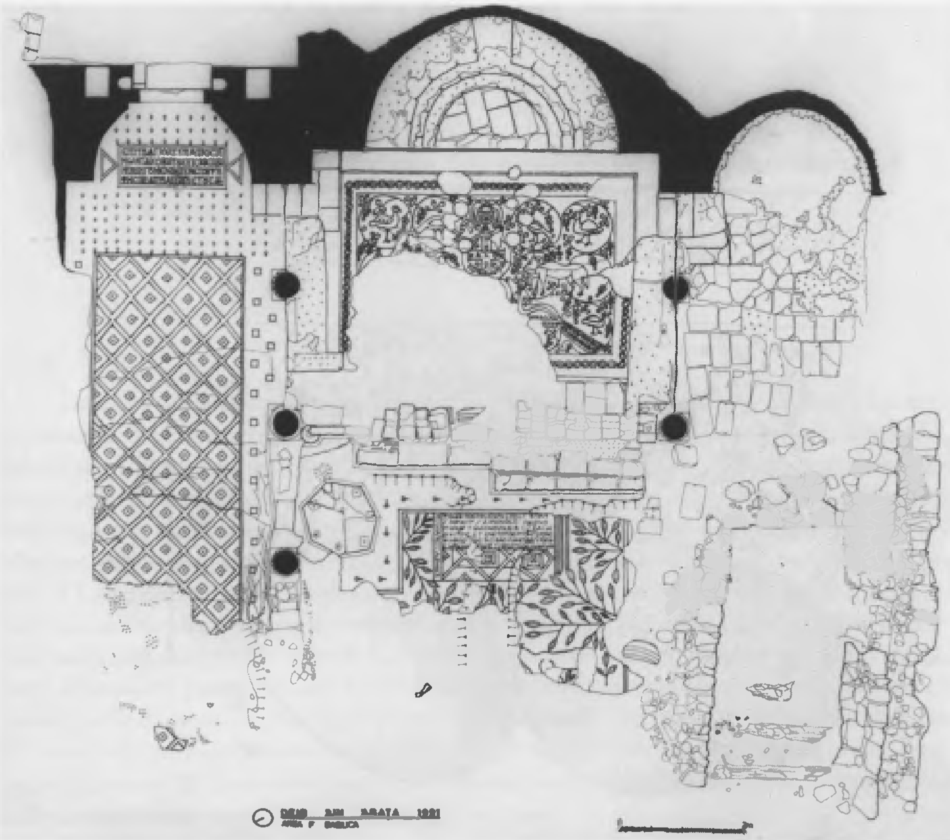


Fig. 3: Initial 1991 top plan of basilical church (by T. Muir and J. Bradbury).



Fig. 4: Aerial view of basilical church, reservoir and monastic buildings as originally excavated in 1991-92 (photo by K. D. Politis).

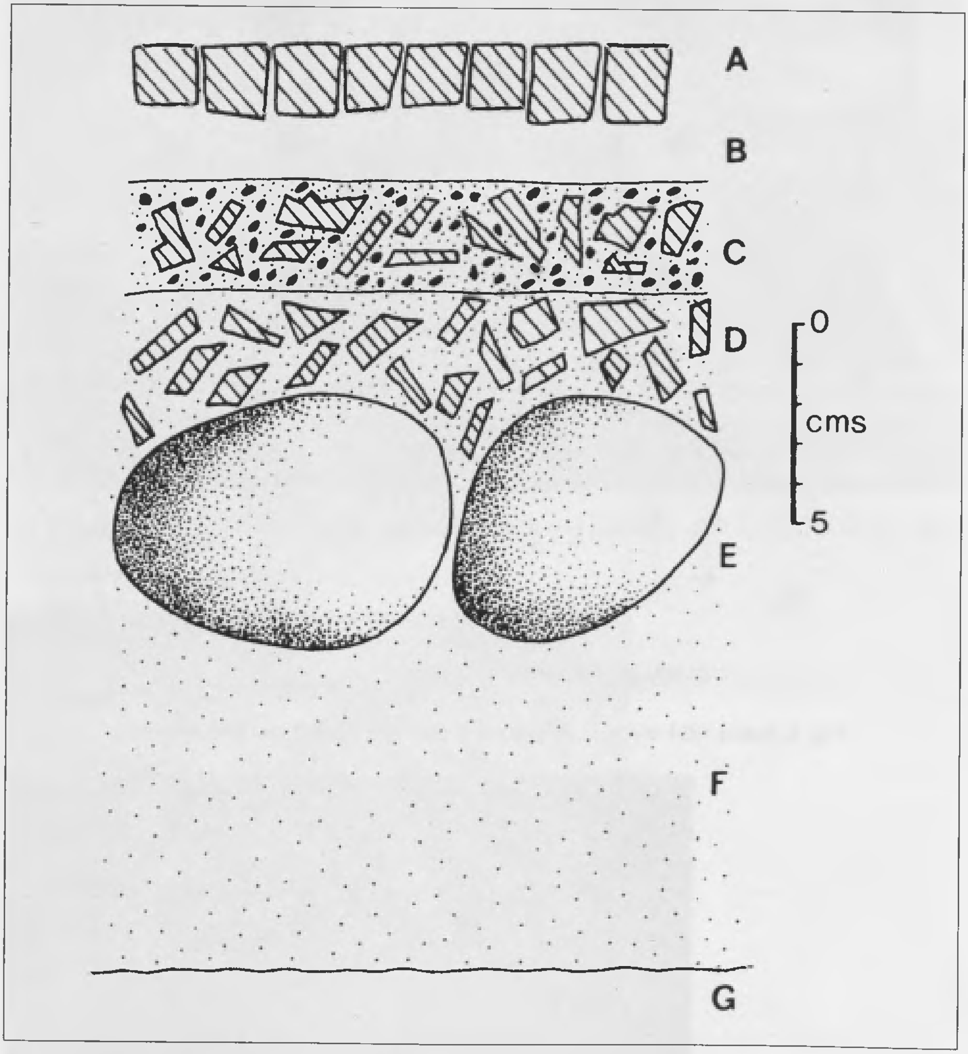


Fig. 5: Section drawing of bedding of mosaic pavement in the nave of church (by S. Chlouveraki).

Luigi Marino*

Relevé «d'urgence» et «relevé dynamique» de dallages mosaïques

Dans les définitions les plus récentes, la restauration s'identifie de plus en plus avec la prévention et l'entretien ordinaire, systématique, et répété dans le temps. Toutefois, dans la pratique, la plupart des interventions revêtent un caractère d'urgence; parfois, parce que les nécessités ne ressortent que dans des phases avancées des travaux et parfois, plus fréquemment, parce que ce n'est qu'au dernier moment que l'on dispose des moyens nécessaires (économiques avant tout). La restauration d'urgence se fixe comme objectif d'assurer à l'ouvrage le maximum de conservation, en exploitant le mieux possible les conditions de sa découverte et en conservant tout le potentiel d'information future [1]. Désormais, tous reconnaissent — même s'ils ne le mettent pas tous en pratique — que les conditions nécessaires pour résoudre les problèmes de conservation de chantiers résident en bonne partie dans un diagnostic de prévention exhaustif[2]. Le relevé (graphique et de l'état de conservation) peut constituer un instrument important, souvent déterminant, pour l'enregistrement et l'interprétation de phénomènes qui risqueraient, sinon, d'être perdus et de conditionner négativement les interventions.

Un relevé correct résout les problèmes dans l'immédiat et peut constituer également un instrument efficace de vérification dans le temps. Pour donner un exemple: la superposition de deux relevés réalisés sur le même ouvrage dans des conditions comparables peut apurer, dans le temps, la correspondance parfaite entre les différentes élaborations. Ou bien, plus fréquemment, elle peut mettre en évidence certaines différences. Celles-ci peuvent être imputées aux relevés mêmes (erreurs dans la récolte d'informations ou en phase de restitution), mais aussi à des différences présentes dans l'ouvrage à cause de trans-

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* The paper was read by Roberto Fiorelli.

[1] Dans le domaine de la restauration archéologique essentiellement, l'on est obligé de travailler dans des conditions d'urgence, à cause des situations précaires qui se présentent et de l'aggravation qui accompagne souvent la bonne continuation de la fouille. L. Marino, "Scavi archeologici e restauri di emergenza", in G. Paolucci (ed.), *Archeologia in Valdichiana*, Roma 1988, pp. 69-72.

[2] La conservation du patrimoine historique exige que l'on prenne conscience de l'inadéquation des enquêtes de base et des vérifications qui constituent l'ensemble d'informations capables de définir des cadres diagnostiques fiables. G. Rocchi, "Presupposti pianificatori e tecniche diagnostiche preventive nell'archeologia urbana e territoriale", *Archeologia Medievale* VI, 1983, pp. 69-76.

formations qui ont eu lieu dans le temps, entre le premier et le deuxième relèvement. Il suffit de penser à la progression de phénomènes cycliques de dégradation des matériaux et/ou de déformation des structures, ou bien au développement de nouveaux phénomènes de dégénérescence.

Le relevé d'urgence [3] peut devenir un secteur opérationnel de grande utilité et de grande applicabilité dans les chantiers de fouille archéologique et dans les chantiers de restauration. Il est évidemment de notre devoir de souligner que les systèmes de relevé que nous évoquons ici n'entendent pas remplacer les systèmes classiques que l'on peut tout à fait utiliser dans des conditions de normalité, lorsque l'on dispose de suffisamment de temps et de moyens adaptés. Les solutions que nous proposons sont à employer uniquement (ou essentiellement) lorsque l'on se trouve dans des conditions où il faut affronter une intervention dans des délais courts et dans des conditions de travail prohibitives à cause de l'accélération des événements, sans pour autant être obligés de renoncer à une quantité adéquate d'informations et à un niveau standard de qualité des résultats. Les solutions proposées peuvent également contribuer efficacement à l'intégration des informations, localisées et spécialisées, lors des campagnes traditionnelles de relevé de surfaces, surtout si elles sont dégradées, ou bien constituer la base pour des relevés pour des «échantillons» représentatifs et significatifs.

Les systèmes de relevé que nous proposons sont fondés essentiellement sur des opérations géométriques, à réaliser sur des images photographiques des sujets en examen. Elles sont réalisées à l'aide de quelques bases mesurées, dans le respect constant des règles de la projection. Les grillages [4] représentent essentiellement l'élément de comparaison dimensionnelle; ce sont des instruments de support, dont l'utilisation s'est généralisée, pour le relevé des zones et des ouvrages archéologiques. Dans le cas de vastes surfaces impossibles à circonscrire dans la zone d'un seul grillage de base, il est possible de répartir l'objet à relever dans plusieurs zones, avec des extensions [5] et/ou des réductions de celui-ci

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[3] Les recherches sur le relevé d'urgence sont réalisées par le "Groupe de Recherche sur la Restauration Archéologique. Conservation et entretien d'ouvrages réduits à l'état de ruine", au Département d'histoire de l'architecture et restauration des structures architecturales de l'Université de Florence, via Micheli, 8. Voir L. Marino, *Il rilievo per il restauro*, Milano 1990, notamment le chapitre 16: "Il rilievo di emergenza". Les enquêtes les plus récentes et les plus avancées ont été effectuées par F. Malesani et M. Valdambrini, *Il rilievo d'emergenza e il rilievo dinamico per il restauro* (thèse de maîtrise, directeur de thèse L. Marino), Firenze 1996, en cours d'impression.

[4] Ils peuvent être constitués de tiges rigides ou de grillages souples (réalisés avec des fils, des lignes à mailles régulières), à placer en contact direct avec la surface à relever (L. Marino 1990, chap. 19: "I reticoli per il rilievo"). Les expérimentations ont été poussées jusqu'à l'emploi de grillages lumineux 'projetés' sur les surfaces à relever.

[5] La méthode dite des "fils du tram" représente une adaptation pratique à échelle réduite, plus adaptée aux caractéristiques de l'ouvrage que les 'bandes' que l'on réalise avec des photographies aériennes (entre autres: P. Merifield and D. Rosencrantz, "A simple method for surveying a small area underwater", *Limnology and Oceanography* 11, 1986, pp. 408-409 et J. Coles, "The site record and publication", in N. Stanley-Price (ed.), *Conservation on archaeological excavations*, ICCROM Rome 1986, pp. 65-77. Pour l'extensibilité des grillages, voir B. Bevan, *Aerial Photography for the Archaeologists*, report from Museum of Applied Science, Center for Archaeology, University of Pennsylvania, Philadelphia s.d.

dans toutes les directions [6]. Ces grillages peuvent être utilisés comme base pour des opérations de mesure directe, en rapportant les points à mesurer aux tiges graduées. Ils sont aussi un support utile pour des prises de photographies [7], à partir desquelles on peut obtenir des mesures au moyen de quelques élaborations graphiques simples. L'avantage est que nous ne sommes pas obligés de toujours travailler en contact direct avec les originaux, et que nous pouvons, le cas échéant, repousser à une date ultérieure les élaborations graphiques (ou des approfondissements particuliers). Les expériences réalisées jusqu'ici ont donné des résultats qui, bien que provisoires, semblent confirmer leur validité et mériter des approfondissements supplémentaires.

Les conditions idéales de prises de vue sont celles où les photos sont réalisées avec l'axe optique de l'appareil placé orthogonalement par rapport au plan, et correspondant au barycentre de l'ouvrage [8]. Dans certains cas, on pourra imprimer la photographie à l'échelle voulue pour la restitution graphique, et en tirer directement le dessin transparent. Dans le cas le plus simple, en utilisant un grillage carré, chaque point à relever sera intercepté des parallèles aux couples de tiges du grillage, et l'on séparera les valeurs des composantes x et y relatives au système cartésien.

Dans la plupart des cas, il est impossible de réunir les conditions nécessaires à la réalisation de photographies orthogonales, à cause d'obstacles contingents, et l'on devra se rabattre sur les séquences (si possible ordonnées) de photos à axe incliné [9]. Les photogrammes que l'on en tirera ne pourront évidemment pas être utilisés directement. Dans tous les cas, et avec quelques limitations seulement, on pourra obtenir les rapports dimensionnels entre les parties, puisque les rapports de proportionnalité entre les parties restent inchangés. Dans ces cas-là, l'image photographique doit être considérée comme

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[6] Le procédé de composition d'images frontales se définit comme *photoplan*. Voir G. Orlando, "Il mosaico fotoplanimetrico: una nuova tecnica per la sua formazione", *XXIII Convegno nazionale SIFET*, Firenze 1978, pp. 1153-76. Il a été démontré que les aberrations possibles avec des appareils-photo 24 x 36 et des optiques comprises entre 35 et 80 mm peuvent être éliminées avec un dépassement d'environ 30% entre un photogramme et l'autre. Il est donc possible de programmer les photographies en définissant l'entraxe entre les points de station qui suivent et les distances depuis le sujet, soit par l'analyse, soit par la pratique. Le montage d'images photographiques en séquences ordonnées présente parfois des difficultés à cause des distorsions dues à une correspondance imparfaite de l'axe optique, et à cause de la variabilité de la distance appareil/sujet dans les différentes prises de vues. S'il est impossible de garder la même distance entre l'appareil-photo et l'ouvrage pour chaque photogramme, on pourra varier la position de l'appareil d'une fois sur l'autre, de façon à reconstruire ensuite les rapports de proportion.

[7] P. Dorrel, *Photography in Archaeology and Conservation*, Cambridge 1989.

[8] Pour les photos aériennes, on peut adopter différentes solutions, trépieds ou grillages plus ou moins complexes. Pour l'utilisation de 'tours' de prises de vue, voir D. Rosencrantz, "Underwater photography and photogrammetry", in Harp (ed.), *Photography in Archaeology Research*, 1975, pp. 265-309. Pour les photos aériennes, voir J. Whittlesey, "Elevated and airborne and stereo photography", in Harp (ed.) 1975, pp. 223-258; P. Federici, "La ripresa fotografica come ausilio al rilievo planimetrico", *Archeologia e Società*, II marte-giugno 1976, pp. 69-71; W. A. Graham, "The MONOPOD. An efficient and inexpensive method for producing distortion-free orthogonal photographs of mosaics in situ", *Bulletin de l'Association International pour l'Étude de la Mosaïque Antique* 7, 1978, pp. 345-356.

[9] Une vison oblique est une image perspective où l'axe optique n'est pas orthogonal au plan de l'ouvrage. B. Bonbon, *Perspective inclinée, ombres reflets, plongeantes, plafonnantes*, Paris 1986.

une image perspective, aussi bien à plan vertical (avec une fuite à l'infini) qu'à plan incliné (avec deux fuites latérales). La recherche de la seule solution possible coïncide avec la recherche des valeurs des variables qui ont permis d'obtenir les photos [10]. Les formes les plus immédiates de restitution dans des projections orthogonales à partir d'images perspectives peuvent être obtenues en appliquant les simples règles de base de la perspective: celles qui lient des points appartenant à des droites parallèles, les points de fuite de ces mêmes droites, et la règle de la dite réduction linéaire [11]. Son utilisation permet de lire, sur la photographie, la mesure d'éléments que l'on peut projeter depuis une fuite sur un élément, qui peut à son tour être mesuré directement sur les tiges graduées du grillage de référence. Cette méthode est très pratique, car elle est liée à la facilité de repérage des points de fuite, en utilisant des lignes parallèles entre elles appartenant à l'objet (cadres, éléments décoratifs...) ou bien, plus fréquemment, des lignes artificielles données par les côtés du grillage. Pour un point de fuite tombant très loin de la photographie, mais non pas à l'infini, on peut avoir recours à une réduction et le transporter à une distance rapprochée plus pratique à utiliser. Des procédés graphiques simples permettront de tracer des bandes de lignes plus serrées que les bandes prévues par la répartition métrique du grillage, et qui répondent davantage aux nécessités de détail et de précision demandées. On a réalisé des expériences sur des ouvrages dont les caractéristiques étaient différentes d'une fois sur l'autre, afin de vérifier [12] les résultats que l'on pouvait obtenir, dans différentes conditions de prises de vue, avec l'utilisation de grillages carrés [13] ou quadrilaté-

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[10] J. Gaudefroy, *La perspective dans le dessin technique, théorie perspective, exécution des notices; conseils pratiques,* Paris 1970; U. Saccardi, *Applicazioni della geometria descrittiva* (chap. VII), Firenze 1970; G. Fano, *La restituzione prospettica da prospettiva razionale,* Bari 1979.

[11] On connaît bien les expériences liées au "positionnement, en perspective, d'un segment à égale distance de deux autres segments" ou "de plusieurs droites à égale distance", le "positionnement d'un segment à une distance connue", la "répartition d'une droite horizontale en n parties" et celles qui concernent les "rapports dimensionnels sur un droite en perspective". Entre autres: E. Jantzen, *Traité pratique de perspective de photographie et de dessin appliqués à l'architecture et au paysage,* Paris 1983.

[12] La phase de contrôle a consisté en une série de vérifications de toutes les données récoltées, de façon à évaluer la congruence entre le grillage, entendu comme 'instrument de mesure', et les exigences de connaissance. La qualité des systèmes s'identifie bien évidemment avec la correspondance entre les performances offertes par la stratégie employée, et les conditions requises placées à la base de la conception du système lui-même. Chaque mesure possède une valeur nominale (réelle) et une relative incertitude (tolérance). Si l'on veut estimer la qualité non pas d'une seule mesure, mais d'un grand nombre d'éléments théoriquement égaux, on peut agir par *recensement* (avec des contrôles pour chaque mesure) ou bien par *échantillonnage,* à travers des contrôles statistiques sur une partie des éléments, en vérifiant que la zone de la distribution effective soit entièrement comprise dans la zone de tolérance (L. Morra e M. Rejna, *Controlli metrici in edilizia,* Milano 1991). Les résultats des expérimentations ont permis l'élaboration de certains tableaux de synthèse intéressants, dans lesquels on compare différents critères de relevé entre eux (relevé à vue, relevé traditionnel et relevé d'urgence basé sur l'utilisation de photographies et de grillages), en fonction des m^2: le temps pour le relèvement, le temps pour la restitution et les coûts. Les avantages et les limites des méthodes comparatives de relevé sont regroupés dans un tableau de synthèse (F. Malesani e M. Valdambrini, 1996).

[13] Les côtés des grillages mesurent généralement 1 mètre, divisé en décimètres; certains d'entre eux peuvent être ultérieurement divisés en centimètres.

raux, triangulaires [14], en croix [15] ou bien de tiges libres [16], devant nécessairement être reliées à un système global de mesure. Les tests ont été poussés jusqu'au cas limite, pour simuler des conditions extrêmes. Les prises de vue réalisées avec des angles variables par rapport à l'angle perpendiculaire au grillage tiennent également compte de la possibilité d'étendre les conditions d'applicabilité du système à une boule des grillages, plus ou moins large. En même temps, on a expérimenté différentes conditions d'éclairage, naturel et artificiel, et différents appareillages photographiques (optiques et pellicules).

Les surfaces essentiellement planes, comme celles des enduits et des mosaïques [17], sont un champ d'expérimentation particulièrement intéressant. Notamment lorsqu'on est en présence de phénomènes dégénératifs de dégradation des matériaux et de déformation des structures, les enquêtes diagnostiques exigent *a fortiori* des soins et une rapidité d'exécution plus importants.

L'adoption de grillages carrés a permis, pour une mosaïque suffisamment régulière, d'obtenir des mesures fiables jusqu'à une inclinaison d'environ 45°, tant sur la verticale que sur l'horizontale. Un point de fuite trop rapproché produit des épaississements de lignes dangereux, et des informations difficilement gérables.

L'extensibilité de la maille obtenue est acceptable uniquement pour les lignes ne subissant pas de déformation perspective; par contre, en phase de reprise, l'extensibilité dans la direction déformée peut se baser sur l'emploi de tiges graduées prolongeant les côtés du carré de référence, ou bien, en phase de restitution graphique, en ayant recours à des pointages graphiques marqués directement sur la photographie au moyen d'une opération équivalant à un dessin en perspective. La diagonale étant l'axe de symétrie pour le carré, on pourra obtenir l'évolution des raccourcis des balayages modulaires à travers le tracé des droites de rappel des points d'intersection de cette diagonale avec les droites résultant de l'alignement sur les côtés du grillage [18]. Les lois régissant la réduction linéaire

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[14] Les grillages rectangulaires s'avèrent plus difficiles à utiliser que les carrés. Ils ont été utilisés le plus souvent dans le relevé de sites subaquatiques.

[15] Nos expérimentations sont une adaptation des expériences de J. Williams ("Exécution de levés sous-marins selon une méthode simple de photogrammétrie graphique au moyen d'obliques", *Musées et Monuments* XIII, 1973, pp. 215-227) pour les levés sous-marins.

[16] On peut les assimiler à un polygone dont les côtés sont les tiges et dont les segments libres sont constitués par les distances entre les sommets de ces mêmes tiges. Les mesures que l'on ne peut pas relever directement sur les répartitions des tiges pourront être obtenues par proportion, en utilisant de façon adéquate le théorème de Thalès.

[17] Les expérimentations sur les mosaïques ont été effectuées notamment au Mont Nebo (Jordanie) lors de missions archéologiques et de restauration dirigées par M. Piccirillo (Studium Biblicum Franciscanum). Pour ces mosaïques, voir: M. Piccirillo, "The Mosaics", in M. Piccirillo e E. Alliata (eds), *Mount Nebo, New Archaeological Excavations, 1967-1997,* Jerusalem 1998, pp. 265-372. Voir aussi L. Marino, "Fouilles d'urgence et relevé des mosaïques de l'Église Nord à Hesban (Jordanie)", *ICCM Newsletter* 9, 1992, "Chronique" pp. 19-20.

[18] Pour des observations sur les éventuels traçages de séparation et, au contraire, sur la restitution, dans des projections orthogonales, des divisions perspectives dans les carrés et dans les grilles à base quadrangulaire, voir: J.H. Gaudefroy, *La perspective dans le dessin technique,* Paris 1970; C. Coulin, *Step by Step Perspective Drawing,* New York 1979.

dans la perspective, applicables également à des éléments géométriques non réguliers, permettent, grâce à des constructions très simples, des divisions perspectives dans toutes les directions, plus ou moins épaisses et capables d'intéresser dans le détail toutes les parties de la surface à relever. Les expérimentations réalisées avec des grillages en croix sont les mêmes qu'avec des grillages carrés, dont les tiges en croix constituent les diagonales.

Toutefois, les résultats les plus intéressants proviennent de l'expérimentation de grillages qui ne nécessitent pas d'appliquer les règles de la perspective, mais uniquement celles de la projection. Nous avons expérimenté des grillages quadrilatéraux réguliers et irréguliers, des grillages à mailles triangulaires (équilatéraux et isocèles), mais aussi des triangles irréguliers et des tiges isolées. Les tests sur les expériences réalisées confirment qu'il s'agit de solutions fonctionnelles soutenables, avec des résultats encourageants si elles sont utilisées correctement: il suffit de respecter de simples règles géométriques, en collant aux particularités des situations individuelles. Les exagérations de certaines expérimentations se justifient par l'intention de tester les limites d'applicabilité de ces solutions.

L'utilisation de grillages triangulaires s'est avérée la plus aisée et la plus riche pour la précision des résultats, l'acceptabilité optimale et la facilité d'extension, tant pour des lignes directionnelles de développement que pour des surfaces en extension, capables de couvrir de vastes zones à relever. L'utilisation de grillages à trois tiges comporte différentes techniques possibles de restitution graphique et des conditions distinctes d'extensibilité du contrôle dimensionnel, en fonction du positionnement de la référence sur la surface: triangle avec un côté vertical et triangle à base horizontale. Les mesurages ont lieu en alignant chaque point à relever avec au moins deux sommets du triangle, et en évaluant, corélativement, la longueur du segment 'détaché' de chaque segment ainsi tracé sur le côté opposé au sommet par lequel il passe. La restitution des points déterminés et des alignements éventuels qui les contiennent sera réalisée grâce au procédé inverse.

Un deuxième système se base sur la possibilité de rapporter chaque point à relever à l'intersection de segments parallèles au côté de référence, en mesurant le segment détaché par une projection, depuis le sommet, sur le côté opposé. Bien que ce procédé ait une zone d'extensibilité réduite par rapport au précédent, il s'avère plus souple et plus précis, puisqu'en phase de restitution graphique, il réduit le nombre de droites à tracer sur l'image photographique.

L'une des conditions qui permettent d'utiliser les grillages comme support pour le relevé en se servant des images photographiques est la coplanarité entre le grillage, la surface à relever, et sa régularité. Dans certains cas, on peut résoudre le problème en réalisant plusieurs prises de vue, coordonnées entre elles, de façon à utiliser les traits réguliers de la surface en ayant recours à une sorte de coupe par plans-grillages de référence. Dans ce but, on peut utiliser des parties de grillage, ou bien des grilles dont la surface est plus petite, sous-multiples des plans de base.

D'autres expérimentations ont permis de vérifier les limites des possibilités d'utilisation des grillages en utilisant les ombres projetées par les tiges [19] sur la surface à relever. La source d'éclairage peut être le soleil, en exploitant le parallélisme des rayons, ou bien

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[19] Leurs répartitions internes sont matérialisées par des ficelles ou des tiges de section plus faible.

une source lumineuse ponctuelle à rayons divergents. Il s'agit donc d'une application utile, employée à l'inverse de la *théorie des ombres*[20]. Grâce aux ombres, bien visibles dans l'image photographique, on peut obtenir les caractéristiques géométriques des objets de départ dans les vues de la projection orthogonale. Il est évident que les meilleurs résultats s'obtiennent lorsque l'ouvrage présente des contrastes plus importants, dérivant de la présence de différences des dimensions dans la direction *z*. Les tests réalisés visaient à la lisibilité de structures qui présentent, quant à elles, un faible contraste entre les parties. De ce point de vue, les surfaces en mosaïque représentent une classe particulièrement difficile, à cause de la prépondérance de surfaces faiblement saillantes par rapport aux surfaces contiguës. Dans des cas comme celui-ci, il devient indispensable d'employer des lumières suffisamment rasantes et modifiables, en rapport avec les caractéristiques de la spécificité des surfaces. Dans ces cas-là, il peut être déterminant de mettre en place un système d'éclairage artificiel, ou de programmer une utilisation optimale de l'éclairage naturel[21]. Une utilisation rationnelle de l'éclairage peut fournir les meilleures conditions de prises de vue, et en même temps, les conditions pour la récolte efficace des données sur les caractéristiques dimensionnelles et sur l'état de dégradation (dépassement des plans, détachement de tesselles, fractures concentrées ou distribuées, atteintes des mortiers de liaison, etc.).

Ces techniques de relevé (avec bien sûr toutes les limitations et la prudence que leur utilisation impose) peuvent jouer le rôle d'anneaux d'une chaîne de vérification, d'élaboration et d'interprétation des données, expéditives mais en tout cas exactes (que l'on peut de toute façon contrôler en cours d'ouvrage et au bout d'un certain temps), destinée à documenter les déformations possibles dans le temps. La comparaison entre les données acquises à des époques différentes peut constituer la base pour le relevé dynamique; celui-ci se trouve à jouer le même rôle que le dossier médical accompagnant le malade durant sa maladie, en documentant les développements en négatif et les améliorations souhaitables. Le replacement répété et ordonné d'un grillage dans la même position que lors du premier relevé[22] peut permettre de réaliser des planches de relevé concernant les conditions relatives à plusieurs classes d'informations. L'enregistrement dynamique pourra constituer le support d'articulation de différentes *cartes thématiques*, à plusieurs clés de lecture, capables de définir les transformations qui ont eu lieu, la rapidité d'évolution et, avec une bonne approximation, de contribuer également à prévoir leur devenir possible.

DISCUSSION

For discussion of this paper see after the paper by D. Weidmann.

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[20] L. Marino 1990, pp. 165-167.

[21] Dans ce but, on a réalisé des expériences avec des écrans opaques et des miroirs capables de refléter l'éclairage naturel de la façon la plus fonctionnelle possible.

[22] Basé simplement sur le repositionnement des points de sommet principaux des grillages de base.

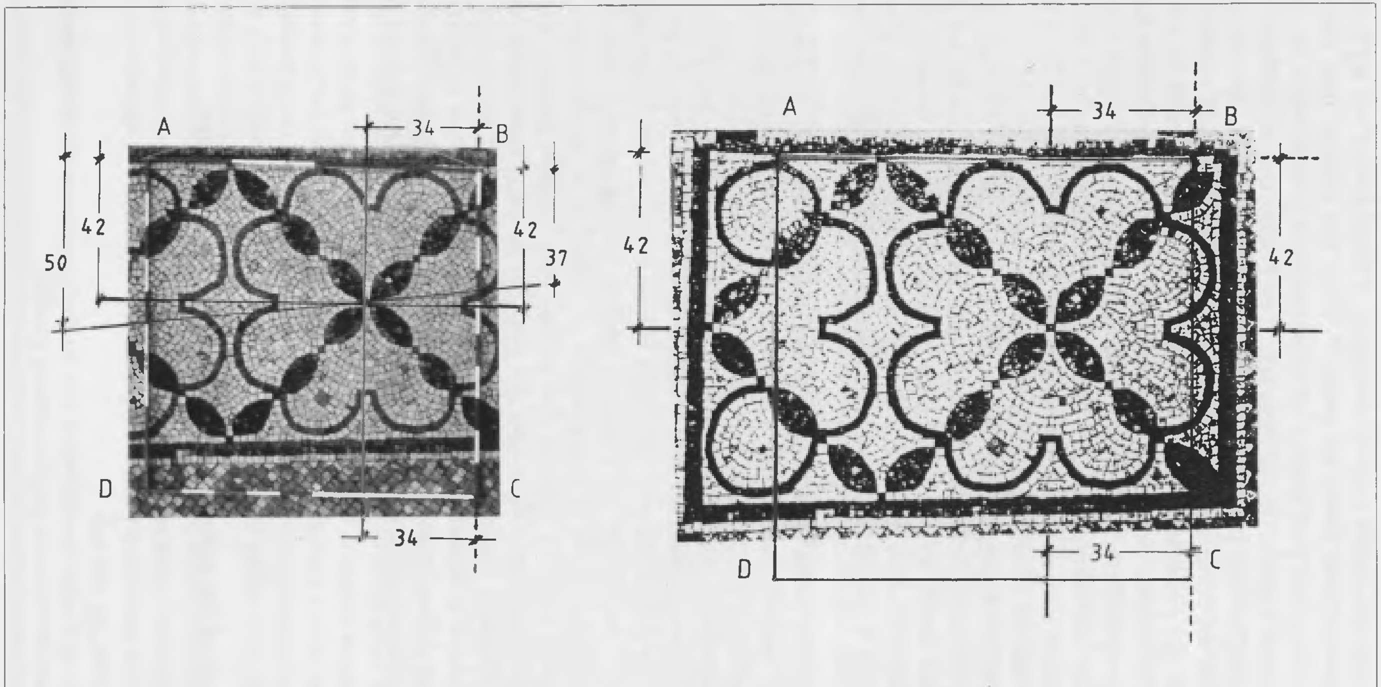


Fig. 1 : Dans le cas d'une photographie parfaitement frontale, (l'axe optique de l'appareil-photo étant perpendiculaire au plan du grillage), on peut obtenir les mesures en envoyant les parallèles sur les côtés du grillage, ou bien en projetant le point (ou les alignements) depuis un élément mesuré d'une tige, sur la tige parallèle à la première.

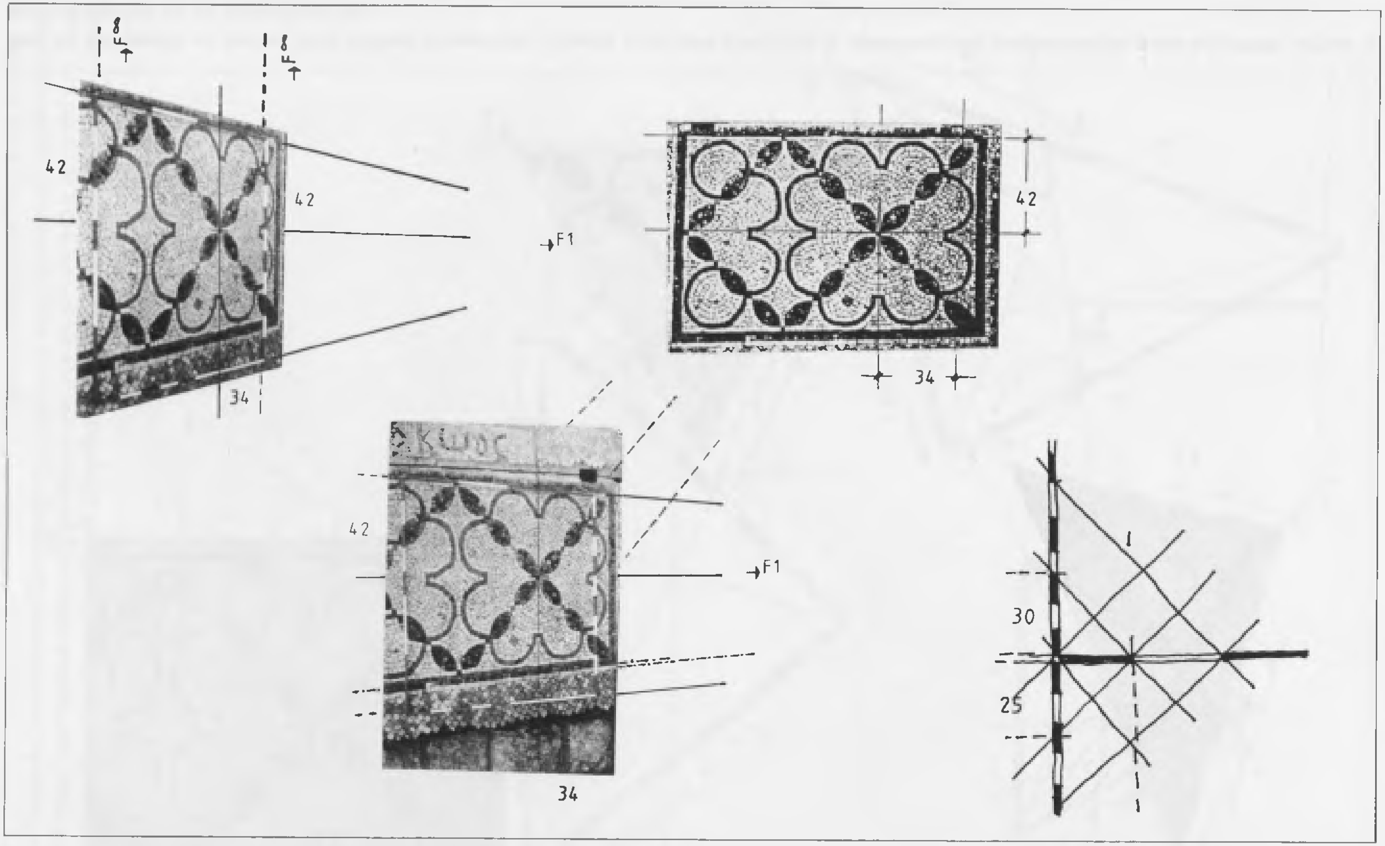


Fig. 2 : Image esquissée dans le plan vertical. Les mesures des points projetés sur les tiges verticales sont vérifiées à travers l'intersection entre les tiges et les alignements vers le point de fuite F1; les mesures projetées sur les tiges horizontales se lisent en utilisant des alignements depuis le point de fuite jusqu'à l'infini. Dans le cas d'une image dans le plan incliné, les projections seront faites depuis les deux points de fuite. L'expansibilité du système se fonde sur la construction de nouvelles grilles (carrées ou rectangulaires), en partant de la base de la grille matérialisée par les côtés du grillage de base.

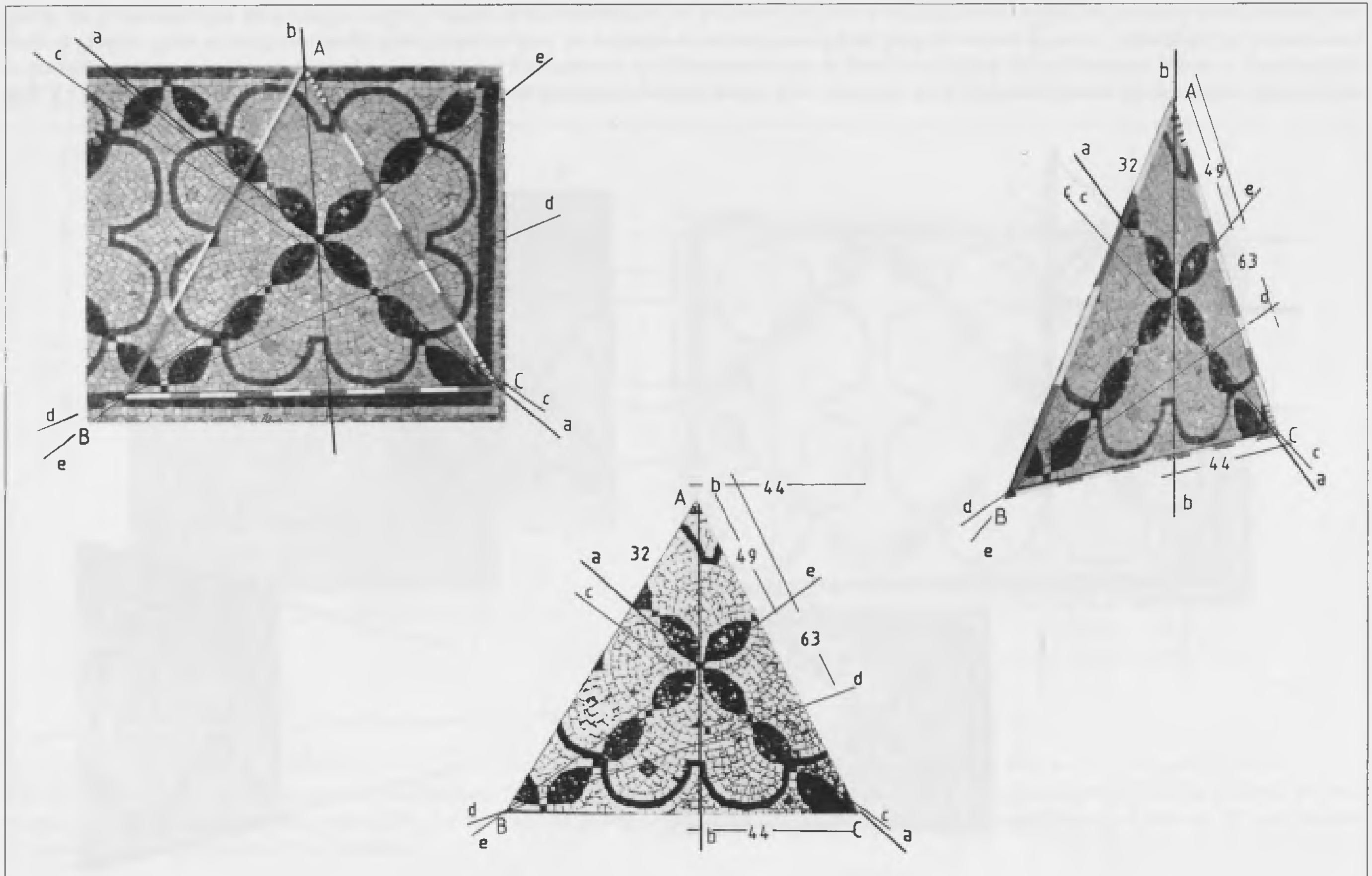


Fig. 3 : Restitution en partant d'un grillage triangulaire. Chaque point sera donné par le croisement des projections du point lui-même, depuis le sommet opposé sur les côtés du grillage.

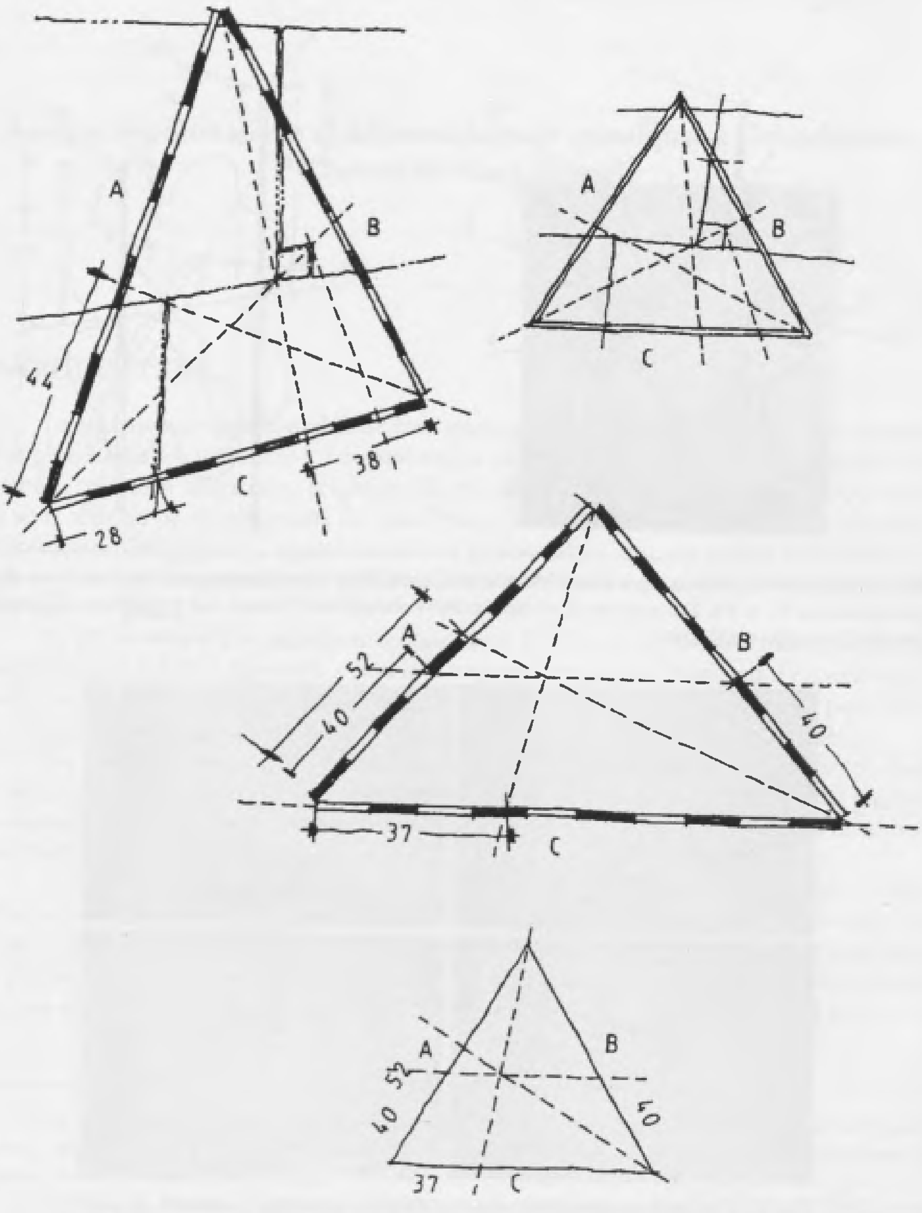


Fig. 4 : Restitution en partant d'un grillage triangulaire: une grille placée dans une position quelconque, l'autre sera placée de façon à ce qu'un côté soit horizontal. Les points peuvent être obtenus individuellement sans utiliser de points de fuite, mais grâce à de simples alignements entre le point et les sommets. Les mesures seront lues sur les côtés opposés.

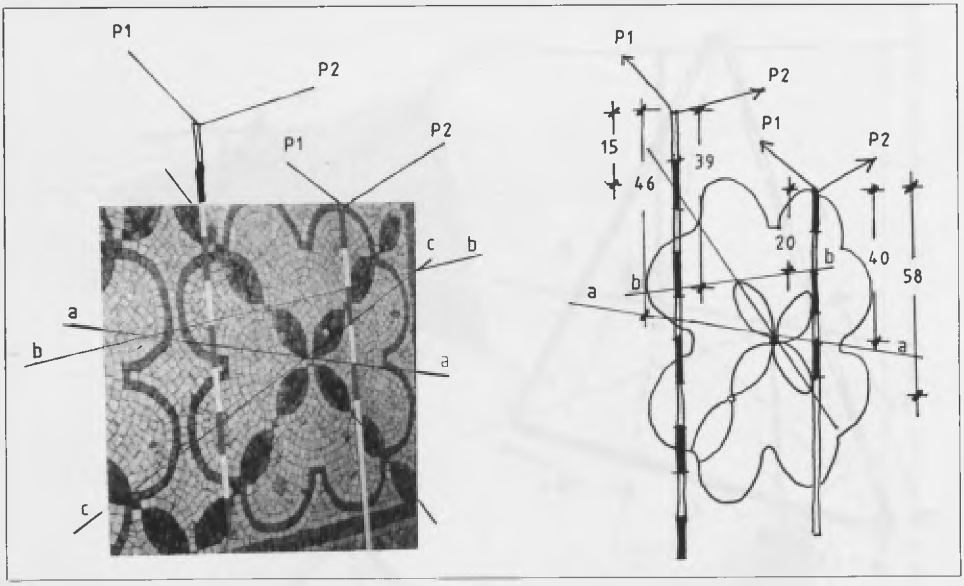


Fig. 5 : Utilisation de deux tiges libres (dans ce cas, parallèles) mais se rapportant en tout cas à deux points connus P1 et P2. Les mesures de chaque point s'obtiennent à travers des projections d'éléments connus d'une tige sur l'autre.

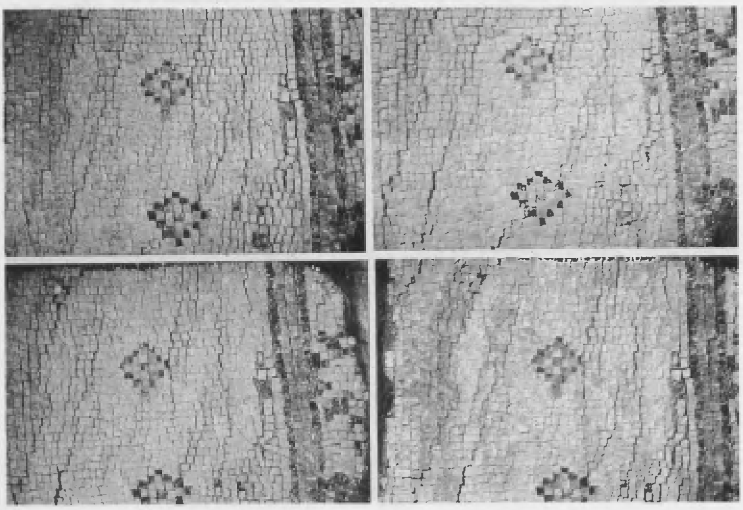


Fig. 6 : Échantillonnage d'une séquence de photogrammes provenant de photographies de la même mosaïque, à intervalles de temps réguliers, de façon à vérifier dans quelle mesure les divers biais de la source de lumière (dans ce cas, naturelle) peuvent contribuer à rendre plus évidentes les déformations et la situation des fissures de la mosaïque. De cette manière, l'on peut programmer les campagnes de prises de photographies de manière plus efficace.

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Analyse des altérations et déformations de mosaïques à Orbe-Boscéaz (Canton de Vaud, Suisse)

INTRODUCTION

La situation de cet ensemble de huit mosaïques conservées *in situ* sur leur support d'origine a déjà été présentée [1]. Les pavements sont abrités sous de petites constructions fermées, mais non climatisées, érigées au fur et à mesure de leurs découvertes, depuis 1841. Ils sont affectés de décollements du tessellatum, de cloquages, d'efflorescences salines et d'altérations de la pierre. L'apparition de ces phénomènes, qui ont atteint des stades critiques pour certains pavements, a été régulièrement signalée une à deux décennies après leur mise au jour.

La découverte d'une neuvième mosaïque en 1993, lors des fouilles méthodiques du site (thème d'Achille à Skyros [2]) a poussé à engager une série d'études et d'expérimentations, pour caractériser l'état actuel, rechercher les causes des dégradations et pour définir les mesures propres à éviter une évolution irréversible après la mise sous abri [3].

Les problèmes rencontrés sont principalement liés à la présence d'eau et de sels dans le sol et dans la mosaïque. D'autre part, les bâtiments de protection ne stabilisent pas suffisamment les conditions atmosphériques au-dessus des pavements, soumis à la dilatation thermique et hydrique des matériaux.

C'est lors de la mise au jour que les problèmes majeurs prennent naissance. Le tessellatum devient l'interface entre un milieu sec (l'air) et un milieu humide (le sol). De l'eau y est donc progressivement évaporée, ceci afin qu'un équilibre hygroscopique puisse s'établir entre les matériaux de la mosaïque et l'atmosphère. Cette évaporation entraîne, par remontées capillaires, de l'eau et des sels du sous-sol vers la mosaïque (Fig. 1). Les

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[1] D. Weidmann, "Problèmes de gestion et de conservation des mosaïques d'Orbe-Boscéaz (Vaud-Suisse), abritées depuis 1841", *IV^th Conference of the International Committee for the Conservation of Mosaics*, Soria 1986, pp. 7-17.

[2] Voir C.-A. Paratte, "Rapport préliminaire sur la campagne de fouilles d'Orbe VD - Boscéaz 1993", *Annuaire de la Société Suisse de Préhistoire et d'Archéologie* 77, 1994, pp. (148-152), 150-151; R. Ling, *Ancient Mosaics*, London 1998, p. 73.

[3] Voir R. Flatt, F. Girardet et D. Weidmann, "In situ conservation of the Roman mosaics at the villa of Boscéaz (Orbe, Switzerland): diagnosis of risks involved", *Materials Research Society Symposium Proceedings*. Vol. 462, 1997, pp. 317-322.

sels, n'étant pas évaporés, s'accumulent progressivement dans les matériaux de surface du pavement. Les concentrations atteintes peuvent provoquer des cristallisations et la désagrégation des matériaux pierreux. Cela se produit tant que la mosaïque n'est pas isolée des infiltrations d'eau par le sol et que l'humidité de l'atmosphère n'est pas stabilisée.

Ces phénomènes étaient sans doute beaucoup moins importants dans l'antiquité, après la mise en place du pavement. Les constructeurs veillaient au drainage des murs et des sols; les bâtiments étaient pourvus de couvertures et d'évacuation des eaux pluviales, qui limitaient le taux d'humidité dans le sous-sol. Les assises de pierre sèche du *statumen* de fondation constituaient une coupure contre les remontées capillaires. Aujourd'hui, nous constatons que les vides du *statumen* des mosaïques d'Orbe sont pour la plupart colmatés par des matériaux argileux, ce qui contribue aux mouvements capillaires constatés.

ANALYSES PÉTROGRAPHIQUES ET POROMÉTRIE (C. Félix)

Un choix de tesselles représentatives, provenant de la mosaïque récemment découverte (et non restaurée), a été observé en macroscopie et en lames minces, analyses complétées par une porométrie par injection au mercure. Il s'agit de roches calcaires d'origine biodétritique, biosparites, oobiosparites pour les calcaires clairs (blanc, jaune, rose, rouge), micrites fossilifères pour les tesselles noires. Le premier groupe présente de manière générale une bonne conservation et des arêtes encore franches. La structure est compacte, avec peu de phénomènes d'altération visibles (quelques microfissures). Malgré une porosité moyenne (entre 4,1% pour les roses et 9,5% en moyenne pour les jaunes/blancs), les calcaires semblent peu touchés par le gel.

Les calcaires sombres sont affectés de pulvérulences, usures, microfissures et fissures qui modifient leur couleur du noir au gris, la porosité passant alors de 2,5% à plus de 12%. Leur dégradation peut aboutir à une totale disparition. Leur teneur en matière organique et en sulfures est probablement responsable de leur sensibilité aux agents physico-chimiques. Ces problèmes ont dû apparaître dès l'antiquité; ils ont motivé de fréquents remplacements par d'autres qualités de calcaires, dans les restaurations modernes.

OBSERVATIONS SUR LE JOINTOYAGE (F. Girardet)

La découverte de la neuvième mosaïque en 1993 a donné l'occasion d'observer l'état d'un pavement enterré depuis l'antiquité, qui n'avait subi aucune intervention de restauration. Le jointoyage antique a été fortement altéré, par dissolution, effet du gel ou de l'activité biologique dans les sols cultivables qui étaient immédiatement superposés au tessellatum. Des restes des agrégats du mortier (sable, tuileau) subsistent dans les joints dégradés. L'adhérence des cubes n'est le plus souvent assurée que par de petites surfaces résiduelles, latérales ou inférieures. La mosaïque ne présente cependant pas de décollements ou de cloques permettant l'infiltration de sédiments argileux ou limoneux sous le tessellatum. Les mortiers de pose paraissent encore peu désagrégés. La conservation de l'ensemble sur son support d'origine est envisageable, dans la mesure où les autres conditions nécessaires seront satisfaites.

Pour les mosaïques dégagées entre 1841 et 1925, le jointoyage a été renouvelé lors des diverses restaurations. Selon les propriétés des matériaux utilisés, ces interventions ont suscité des comportements très variables du tessellatum.

Un prélèvement et une coupe mince (Figs 2-3) ont été effectués dans une zone de décollement particulièrement active d'une mosaïque dégagée en 1841 (no. 6, cortège rustique). Les soulèvements y atteignaient plusieurs centimètres de hauteur au dessus du mortier de pose, qui apparaît localement très désagrégé.

On a constaté la disparition quasi-complète du jointoyage inférieur. La liaison avec les cubes voisins n'est plus assurée que par un pont superficiel, composé dans ce cas de ciment Portland. Ces joints réalisés vers le milieu du 20e siècle ont réagi avec les sulfates contenus dans le sol, produisant des gonflements et des tensions qui ont fracturé une partie des cubes. Les risques d'effondrement du tessellatum affaibli et suspendu sur de grandes surfaces a nécessité un entoilage préventif, puis la dépose de l'ensemble en novembre 1998.

LA DILATATION DES MATÉRIAUX ET LES DÉCOLLEMENTS DU TESSELLATUM (R. Flatt et F. Girardet)

En théorie, la variation de hauteur d'une cloque de soulèvement d'une mosaïque, assimilée à une calotte sphérique, dépend de son rayon et de la racine carrée du produit entre le coefficient de dilatation thermique (ou hydrique) et la variation de température (ou d'humidité).

On a donc mesuré en laboratoire le comportement des tesselles et des liants en fonction des variations de la température et de l'humidité, et ainsi déterminé leurs coefficients de dilatation respectifs, à l'aide de chambres de simulation atmosphérique [4].

Le coefficient de dilatation thermique moyen mesuré pour les calcaires d'Orbe est de 12 microns par mètre et par degré. Il en résulte qu'une variation de température de 30 peut entrainer un soulèvement de 1,3 mm pour une cloque de 5 cm de diamètre, et de 4 mm pour un diamètre de 15 cm.

Le rôle de la dilatation hydrique est beaucoup plus faible, (coefficient de l'ordre de 1 micron par mètre et par pourcentage d'humidité relative), ce qui indique que les variations d'humidité ne sont pas les causes premières des mouvements constatés.

Le comportement des joints en mortier de chaux ne peut être qu'évalué ; il intervient pour 5 à 10% dans les hauteurs de décollement.

LE CLIMAT D'UNE MOSAÏQUE SOUS ABRI ET LE MOUVEMENT DE SES CLOQUES

Les décollements dramatiques observables sur certaines mosaïques d'Orbe mesurent jusqu'à plusieurs centimètres de hauteur. C'est le résultat de la superposition de phéno-

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[4] Flatt, Girardet et Weidmann 1997, pp. 318-320.

mènes survenant au cours des cycles climatiques quotidiens et annuels qu'elles subissent, pour certaines depuis plus de 150 ans.

Un dispositif de mesures *in situ* a permis de mesurer les mouvements et déformations de quelques points de la mosaïque 6 au cours d'un cycle annuel, de novembre 1993 à fin octobre 1994. On a mesuré simultanément les séquences de température et d'humidité à l'extérieur de l'abri et dans l'ambiance intérieure, ainsi que la température dans le tessellatum et à une dizaine de centimètres de profondeur sous le *statumen*.

Il a été confirmé que le bâtiment érigé en 1841, en maçonnerie traditionnelle, amortit les variations quotidiennes du climat extérieur d'un facteur de 4 à 5. Cependant, la toiture non isolée transmet des échauffements rapides en cas de fort ensoleillement des tuiles. Il en résulte des brassages de l'air intérieur et des variations importantes de l'humidité relative, laquelle règle le taux d'évaporation en surface du tessellatum, ainsi que sa température.

Sur la base des mesures effectuées en 1993-1994, le cycle climatique subi par la mosaïque peut être décrit schématiquement comme suit (Figs 4-5).

De mi-novembre à fin février, les températures de l'ambiance intérieure, du tessellatum et du sous-sol sont très proches. Elles restent inférieures à 5, avec plusieurs passages du 0. Le rayonnement de la chaleur accumulée dans le sol au cours de l'été précédent limite le risque de gel pendant le début de l'hiver.

La surface froide du pavement est marquée par de fréquentes zones de condensation, résultant des fortes valeurs d'humidité relative régnant dans le bâtiment. Dès mars commence un réchauffement progressif qui amène l'ambiance intérieure à 20-25 en juillet-août. A partir de mai, le réchauffement du sous-sol est en retrait de quelques degrés par rapport à celui de l'air, dont le taux d'humidité s'abaisse.

Le tessellatum évapore constamment durant la 'saison chaude', ce qui abaisse sa température de 4 à 6 par rapport à l'air. La surface du pavement reste également plus froide que le sol sous-jacent.

Dès fin août, les températures décroissent et l'humidité relative augmente. La période de l'évaporation prend fin vers le début octobre, quand la température de l'air et du tessellatum se rejoignent, vers 10. Les condensations réapparaissent simultanément.

Les mouvements verticaux mesurés par capteurs sur des zones de décollement actives de la mosaïque 6 (Fig. 6) sont le plus souvent corrélables avec des phases d'élévation de la température dans l'abri, confirmant en cela le modèle théorique. Les déplacements peuvent atteindre plusieurs dixièmes de milimètres sur quelques jours. Mais il se produit aussi des mouvements contraires (une cloque peut monter alors que sa voisine descend), ce qui indique l'interaction de nombreux autres phénomènes. Le comportement des joints y est vraisemblablement associé. Leur composition a été modifiée par les multiples restaurations et injections subies, ainsi que par les dépôts des sels remontant du sol.

L'analyse ayant clairement montré la nécessité de stabiliser les conditions climatiques dans les bâtiments de protection, les toitures de deux d'entre eux ont été isolées thermiquement. Les variations quotidiennes de la température et de l'humidité y ont aussitôt diminué d'ampleur (Fig. 5). Le taux d'humidité relative se maintient dans des valeurs élevées, de l'ordre de 90% en période froide (octobre à mars). Il ne descend qu'occasionnellement au dessous de 75 à 80% en période 'chaude' (avril à septembre). L'améliora-

tion de l'étanchéité atmosphérique du bâtiment pourrait sans doute être poursuivie, de manière à limiter encore l'évaporation des mosaïques.

LES RISQUES LIÉS AUX SELS DANS LE TERRAIN (R. Flatt)

La mise sous abri des mosaïques à Orbe a eu pour corollaire une évaporation incontrôlée et des dépôts de sels, marqués notamment par des efflorescences. Les autres conséquences sont plus difficiles à constater, comme la diminution de porosité, les désagrégations imputables aux cristallisations, etc.

La mosaïque 9 a donné l'occasion d'évaluer les conditions d'une situation initiale[5]. Un percement existant dans le pavement a permis le prélèvement d'échantillons jusqu'à une profondeur de 70 cm environ. Il a été possible de mesurer la teneur en eau et en sels sous un pavement en début de drainage, mais dont la surface a été rendue étanche à la vapeur d'eau et isolée thermiquement pour éviter son évaporation en surface.

La teneur en eau sous la mosaïque était dans ce cas de 12 à 13% de la masse du terrain sec. L'analyse des sels aux diverses profondeurs montre, à côté des carbonates, de fortes teneurs de sels d'origine naturelle, comme le calcium, mais aussi d'autres imputables aux activités agricoles (potassium). Les modèles et calculs théoriques des séquences de cristallisations, appliqués à la composition saline constatée, prédisent une phase de dépôts salins particulièrement critique entre 70 et 80% d'humidité relative dans l'atmosphère, taux qui se répercute rapidement sur l'humidité de la mosaïque elle-même.

Le calcul montre en outre que la masse des sels sous-jacents à la mosaïque, s'ils se déposent complètement dans la surface du tessellatum, peuvent atteindre 2 à 3% de la masse des tesselles. Ils peuvent donc réduire fortement, si ce n'est totalement la porosité des calcaires.

Enfin, la nappe phréatique riche en sels peut alimenter le processus d'évaporation, si le drainage est déficient ou inexistant. Si le problème du drainage est parfaitement résolu, le séchage du pavement peut être envisagé, en l'amenant en dehors de la tranche critique d'humidité relative, et en absorbant les sels résiduels.

Dans cette perspective, la mosaïque 9 a été drainée sur trois côtés, par des tranchées profondes de 1 à 1,5 m ouvertes autour des murs entourant la pièce. Le quatrième côté était occupé par le sol d'une chambre voisine, auquel il n'était pas souhaitable de porter atteinte.

Le dispositif s'est avéré insuffisant, vu la présence d'un sous-sol morainique très argileux et d'une nappe phréatique superficielle qui alimente la forte capillarité du sous-sol de la mosaïque.

Dans l'attente d'un drainage plus efficace, étendu à une plus grande partie du site, on cherche à maintenir le pavement dans un climat proche de celui qui prévalait avant sa mise au jour. Un abri en bois, non isolé, protège le site des intempéries (Fig. 7). Pour évi-

[5] Flatt, Girardet et Weidmann 1997, pp. 320-322.

ter les altérations dues au séchage par évaporation de surface, ainsi que les dégâts dus au gel, la mosaïque a été couverte de filtres industriels en polyether, d'un film de polypropylène et finalement d'une couche thermiquement isolante en laine de verre (épaisseur env. 20 cm).

Le bon comportement de ces protections temporaires s'est confirmé au cours des cinq dernières années, tout en laissant un accès aisé au pavement pour toute intervention ou contrôle. L'humidité reste saturante en toute saison au niveau de la mosaïque. Le relevé comparé des températures à l'air libre, dans l'abri et au contact du tessellatum isolé montre que les chocs thermiques du cycle annuel sont bien amortis (Fig. 8).

La température de la mosaïque ne descend pas plus bas que +5 et reste ainsi à l'abri d'un gel qui serait catastrophique, dans son état saturé d'humidité.

DISCUSSION

MacLean: That was an interesting example of presenting scientific information, probably very useful for the next people who will attempt to undertake a similar project at that site. We have had three very different papers touching on the fringes of documentation in the way that we were talking about it earlier with Mr. Corfield's presentation.

Corfield: I would like to thank Mr. Weidmann for his very elegant presentation of the salt measurement and salt reduction, which I think goes considerably beyond what we have been trying to do in England. And I think we clearly have a lot to learn from your methodology. I am particularly interested in the idea of trying to reduce the salts in the ground immediately below the mosaic, and I would be very interested to hear how successful that is.

MacLean: Following on the earlier discussion, Gaël (de Guichen) wanted to reiterate the importance of comprehensive documentation. We have seen these three very specific presentations, but I think he wanted to reiterate the importance of the more contextual documentation looking at these aspects of the micro environment but also the macro environment, looking at cultural landscapes as well as just the site, just the mosaic, which I think has probably been the focus of a good deal of the work of many of us. However, I wonder how useful the idea of calculating how many square metres of mosaics really is; I wonder if national inventories are the rule or the exception to the rule in the regions represented in this room. Are national inventories made of these resources other than in the U.K., and are they useful?

Neguer: [trans.] It is very difficult to undertake an inventory of resources when you have nowhere to put all of the inventory. If a country does not have a national inventory of mosaics, it is very difficult to do an inventory, and then to assess all the mosaics so as to have a high-level logistic approach. But what we can do is surveys of an entire country which would enable us to assess the resources. I think it would

take two years for each country which, like my own, is very undeveloped in this field, and in that way, we could have an excellent overview with a map with all the points in red and black and on that basis you could calculate the cost of rescue, maintenance, conservation, and presentation work. But each country is responsible for asking its own institutions to begin work if it has not already done so.

MacLean: This brings to mind an attempt that the World Heritage Committee has made to encourage the idea of the indicative lists. I don't know how many of you are familiar with this, but the underlying idea of it is that if, for example, there is a site, perhaps a Roman villa, that is going to be nominated for World Heritage status, it is now seen by the committee as a very good idea to do a much broader inventory of that kind of site so that when one begins the nomination process, the relative value of that one site that may be nominated is clearer compared to the value of the others. Someone pointed out earlier this morning the need for these broader surveys and one good use of this is to begin to understand the value of these related sites so that they can begin to fill in some sort of prioritized list for maintenance and activity.

Ben Abed: [trans.] I would like to draw your attention, Mme. Chairman, to the existence of corpuses in a number of countries, and that we have had inventories of mosaics for some years or even some decades. We have been strongly encouraging the publication of corpuses of mosaics, which are not mere inventories but which contain a very detailed description of the state of conservation and all other useful comments for conservators or art historians. These corpuses are the future of documentation. They do exist in Tunisia; they have already been published, and I am partly responsible for publishing these works. We have already reached the eighth volume, and we are systematically covering Tunisia. It is also true of Spain and Italy, where they are doing the same thing.

Palumbo: I think that national inventories and corpuses, just as Aïcha (Ben Abed) said, are useful; only by knowing what we have, do we know what we have to save and what we have to spend to save this heritage. A number of countries all over the world are now engaged in inventorying and evaluating their heritage, and I think that the fact that so much effort has been put into this exemplifies how much interest there is in this. I fully support any idea of continuing with the inventories and starting with a serious evaluation of this heritage.

MacLean: Dr. Palumbo says this because he was instrumental in developing the national inventory in Jordan.

Skaf: [trans.] I would just like to note the presence in this assembly of Lebanese conservators who work privately and who trade in mosaics in Lebanon. Trading mosaics is legal and will not stop right now, but as trading will go on, I hope this session will encourage them to participate in the national recording and documentation of mosaics which leave the country or which are marketed regularly.

MacLean: Because they seem so permanent and so architectural, it is easy to forget that mosaics can be lifted and taken away. They should be treated in the same way as valuable church furniture that has been looted from many churches around the area as well.

Corfield: Regarding the indicative lists on World Heritage sites, I would like to ask to what extent does designation of a World Heritage site tend to draw resources away from other sites? As we know, in World Heritage sites, we have to have a management plan, and we have to have a programme for the site. But resources are finite, and unless the plan indicates additional resources, then there is the risk of a loss of resources to other and perhaps more pressing needs.

MacLean: That is a very interesting point and a very difficult problem. Not much research has been pointed in that direction yet, but I hope that this will encourage someone to do it.

Stanley-Price: Several references have been made to the importance of inventories letting us know what we have. An inventory well done also shows us what we no longer have. Gaël (de Guichen) referred to the inventory in Sardinia of mosaics which still exist and the attempt at identification of costs involved in maintaining what is already known. If you will excuse me for referring to a study I did myself, in the Aquileia conference of this committee, I tried to review the present status of a whole series of mosaics with a particular motif of inhabited scrolls, exploiting the doctoral thesis of Claudine Dauphin and doing a very simple study of over 150 mosaics with this particular motif, what had happened to them since they had been found, dividing them into those which had been left *in situ* and those which had been removed to museums, those which had been stolen, and it gave a fairly horrific picture of how much of the original mosaic inventory had actually gone. So, I would urge that that information be included in any inventories that are undertaken. Just because the mosaic no longer exists, do not exclude it.

MacLean: That is a good point. There was another point that was brought up this morning very briefly, the question of what to do with the information once it has been collected; what happens to the archives? This goes to the point that I was making and others were making also about to what uses is the documentation going to be put? And what happens to the data? If one collects massive amounts of electronic data, for example, how is that curated? And this is increasingly a question I think for those organizations with access to the higher end technology. Unfortunately, there is no very good answer about the longterm archiving of electronic media. We know tape is rather short lived; CDs may be a bit longer lived, but does one archive the hardware along with the storage medium along with the software? This is an interesting problem which argues, of course, in many people's minds for the retention of traditional recording techniques, at least as a check on the electronic forms.

Margalit: I would like to ask Ms. Chlouveraki if she thought about undertaking conservation of the mosaic *in situ.* I understand that it will be lifted, but if it is returned to the site, it will have lost its historical context. I like the situation of the mosaic, but that will be lost if it is flattened. So, can you tell us briefly if you thought about other ways to do it, and what is the solution now?

Chlouveraki: As I said while presenting my paper, the conservation strategy of the project on the site was to maintain the mosaics as far as possible *in situ.* In the case of this one mosaic this was not possible, according to my opinion and to that of other conservators who were present on the site. This opinion was based on the location of the mosaic, which was right at the edge of the cliff, and on the damage suffered by the mosaic over three years. During these three years, two or three conservators worked on consolidating the tesserae which had been lost the previous year. We had an accurate tracing tessera by tessera of the mosaic floor when it was uncovered, before any conservation and restoration had been done on it. And every year we could identify new losses of the material, even the mortars; the consolidation mortars of the edges would break and fall off the edge. The site has three mosaics and a plain one without decoration within the cave. So, although we kept three *in situ,* we thought that the only way to secure the fourth mosaic was to lift it. There was also the matter of visitors, too, and animals. During the first years the site was left unguarded. Now the site is guarded and protected by the Ministry of Tourism. The development of archaeological sites into tourist attractions is now a major project, and the site is now safe. But at that time, in 1994, that seemed to be the only solution. The bedding of the floor has already been reconstructed, as you saw in my slides, and has been flattened. The mosaic itself has also been flattened, and, as far as I know, it is going to be relaid in a flat position. That is a decision for the director, because these decisions are not made by me or by any of the conservators; they are always made in conjunction with the director and the local authorities. And they would like to have the mosaic flat, but not to be stepped on; there will be walkways around the mosaics to enable visitors to walk around and see the church.

Menicou: [trans.] With reference to excavations in the Middle East on sites where we have a lack of protective legislation for archaeological sites and mosaics, we are talking about a ministry of tourism protecting a mosaic. That is unacceptable. We know that universities undertake their excavations in Cyprus and elsewhere, and by the following year serious changes have taken place in the condition of the excavated remains which were dug the previous year. When the excavations are temporarily suspended, as between seasons, the sites are left without protection.

Chlouveraki: [trans.] I must tell you that the first years when these mosaics were exposed, no protection was offered by the government; the archaeological group which excavated the site was not present all the year round, and therefore could not offer any substantial protection to the mosaics. As a result, large and significant sections of two of the mosaics, which I did not show you, have been stolen. When we went

back the following year, there were two large holes, and the mosaic was missing from those points. Happily, however, the site has been incorporated in the programmes of the Ministry of Tourism and Antiquities of Jordan for its protection. And the government has now installed guards, two shifts throughout the day, and one night shift to protect the site. The government has also funded the restoration and conservation of the building. It has partly funded the mosaics themselves, but I would also like to say that most of the work on the mosaics has been done through funds from private donors raised mainly by the efforts of Mr. Politis, the director of the excavation; a concert took place in Italy, for example, and money from this concert was put towards the costs of conservation.

Blanc: [trans.] I would like to ask if you had a local site training programme, or was it a foreign team which did the work, returning to Jordan each year?

Chlouveraki: [trans.]: Until now, the group has been composed mainly of archaeologists from the British Museum, also conservators, and a group of mosaic preservers, which I organized and brought from Greece, from the T.E.I. school in Athens. Essentially there were two students who worked with me, not Jordanian students but students of the Greek university. A school has now been established at Madaba in Jordan which specializes in mosaics, and we are considering the possibility of using people from this school when the time comes for the resetting of the mosaic. These students can do their training with us and help us reset the mosaic, as well as undertake the *in situ* conservation of the other two mosaics which were left during the excavation. One has been restored; treatment of the other one is just beginning. We hope that this school, which has now been operating for three or four years, will be able to supply us with students who have already studied the subject for two or three years and who want to learn more.

Piqué: I would like to go back just one second very rapidly to the use of documentation and take up the point that Mr. Corfield raised before. Once a project is finished and we have collected an enormous amount of written and graphic documentation of the scientific results, how is this material to be stored in an easily retrievable form? I would like to know if anyone has useful information on that. I am also interested in how documentation is used for the longterm monitoring of the site; this is after the treatment is done, to follow the mosaic, wall painting or whatever after treatment, and how changes can be identified and documented using the past information.



Fig. 1 : Front d'évaporation et d'efflorescences salines sur la mosaïque 8 (1862), résultant d'un drainage insuffisant.



Fig. 2 : Mosaïque 6. Face inférieure d'un groupe de tesselles prélevées en bloc dans un soulèvement actif. Les contraintes et mouvements ont éliminé la totalité du jointoyage.

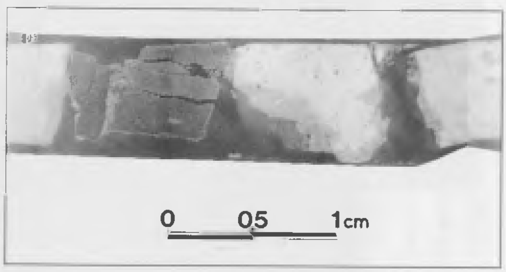


Fig. 3 : Coupe mince au travers du même échantillon (Fig. 2). Fissuration des calcaires sombres altérés et résidus de jointoyage.

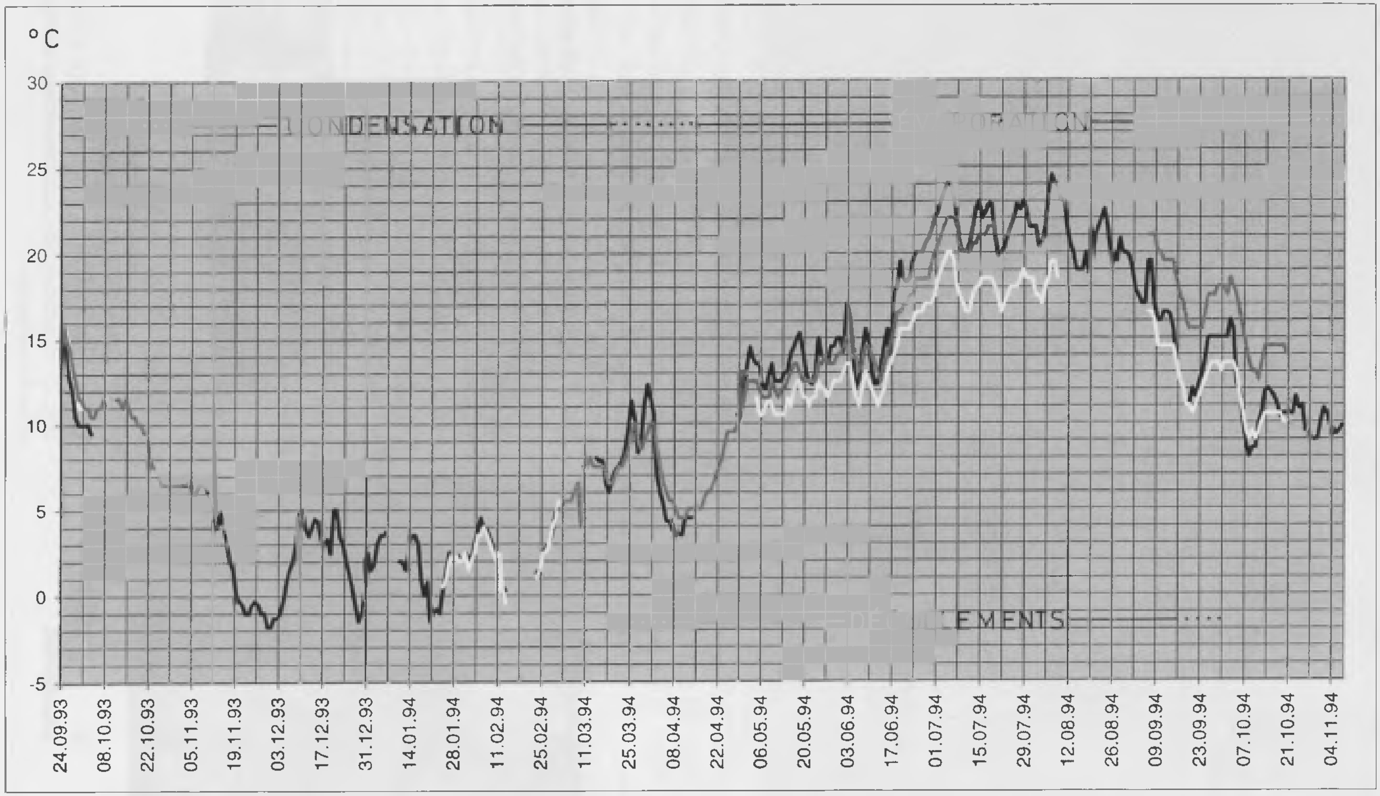
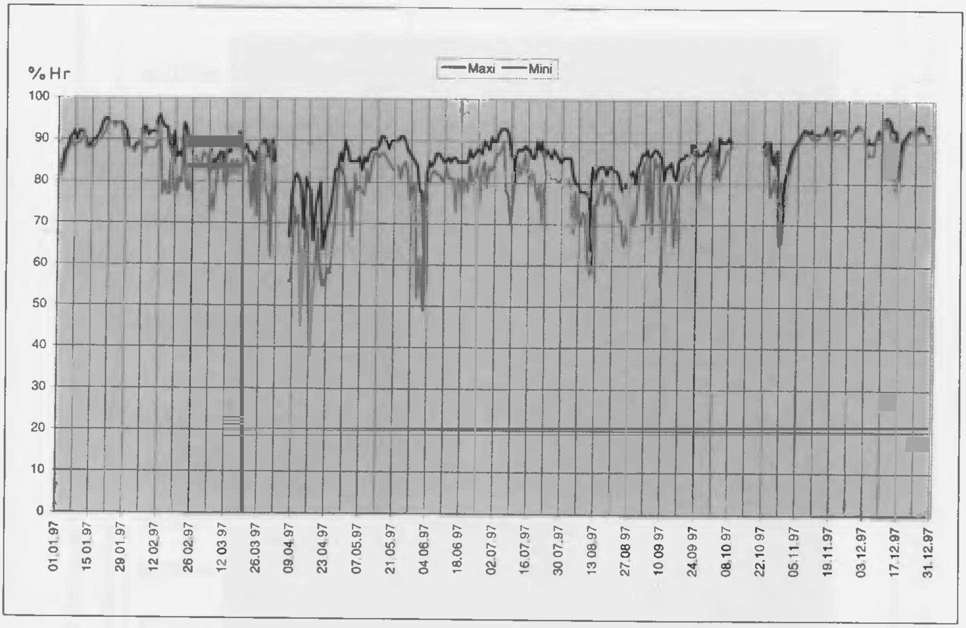


Fig. 4 : Mosaïque 6. Cycle annuel 1993/1994 de la température intérieure (noir), sur le tessellatum (blanc) et sous le *statumen* (gris).



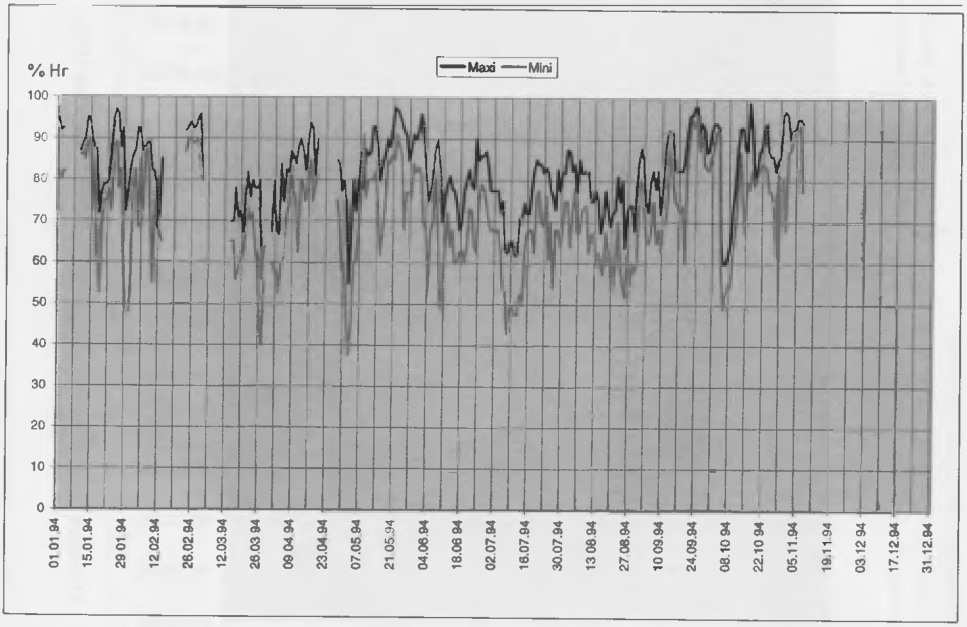


Fig. 5 : Mosaïque 6. Variations annuelles du taux d'humidité relative dans l'abri avant (1994) et après (1997) l'isolation de la toiture.

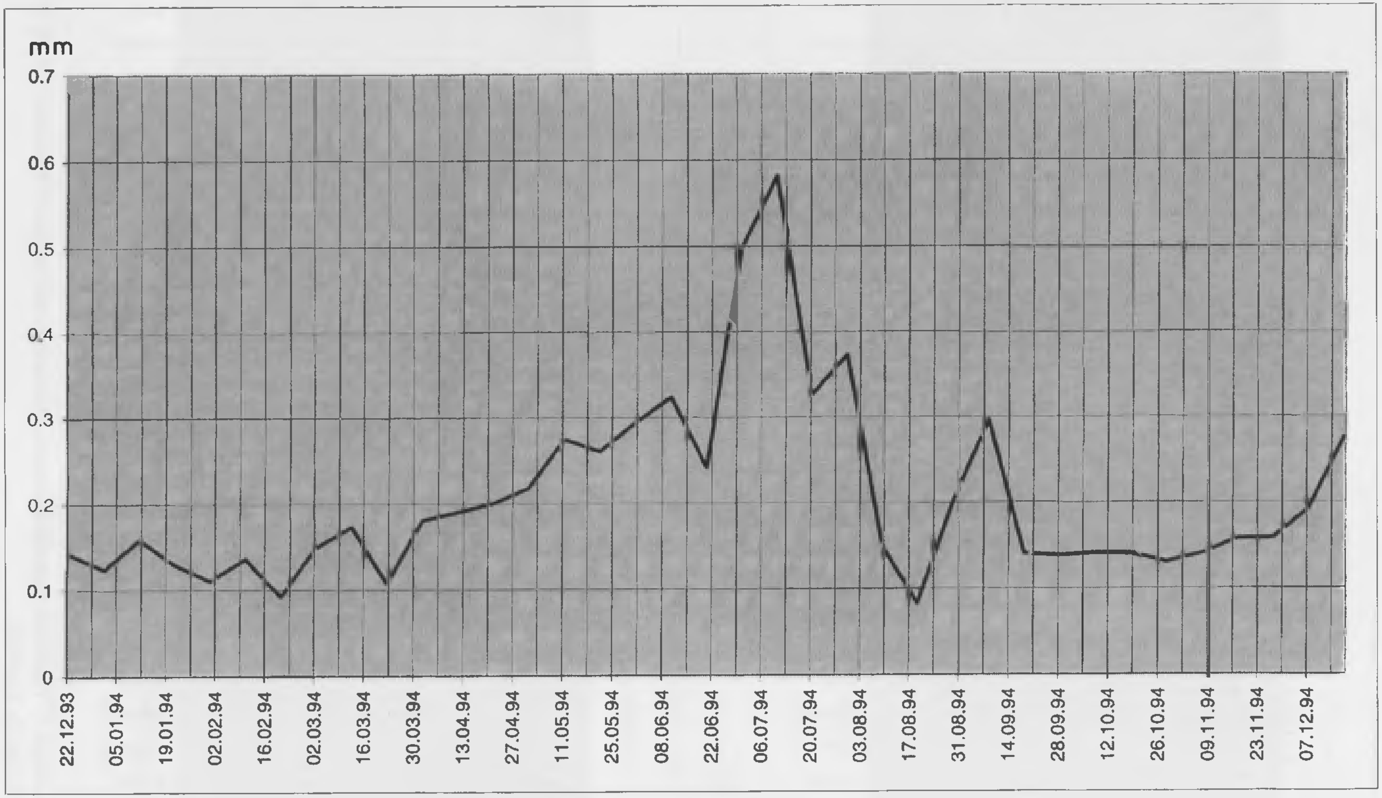


Fig. 6 : Mosaïque 6. Mouvements verticaux d'un décollement en 1993-1994. La plus forte amplitude représente une hauteur de 1,25 mm environ.

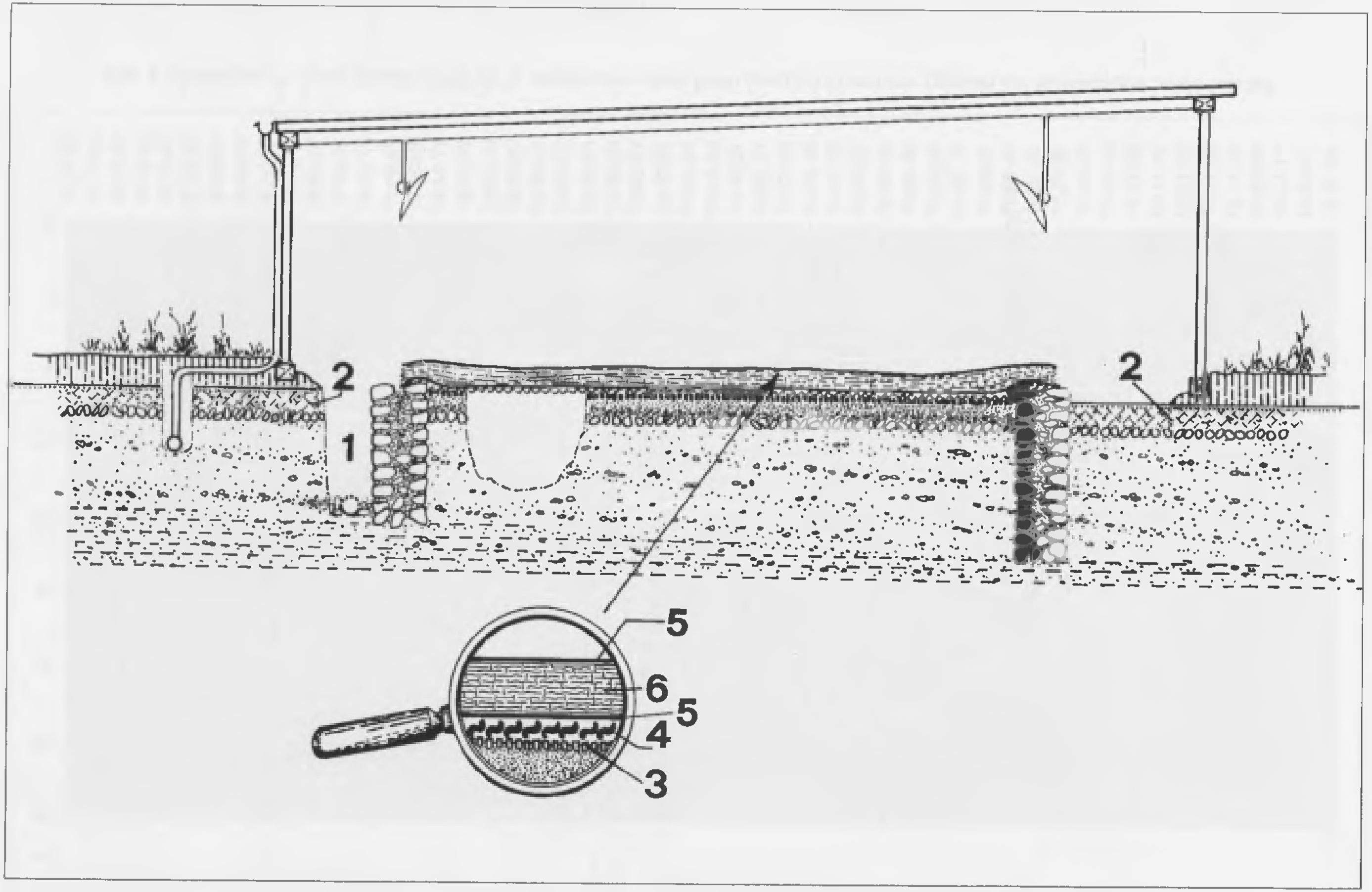


Fig. 7 **:** Protection provisoire de la mosaïque 9 maintenue en état humide. 1: drain. 2: sol des pièces voisines. 3: tessellatum. 4: filtre industriel. 5: film polyéthylène. 6: isolant thermique.

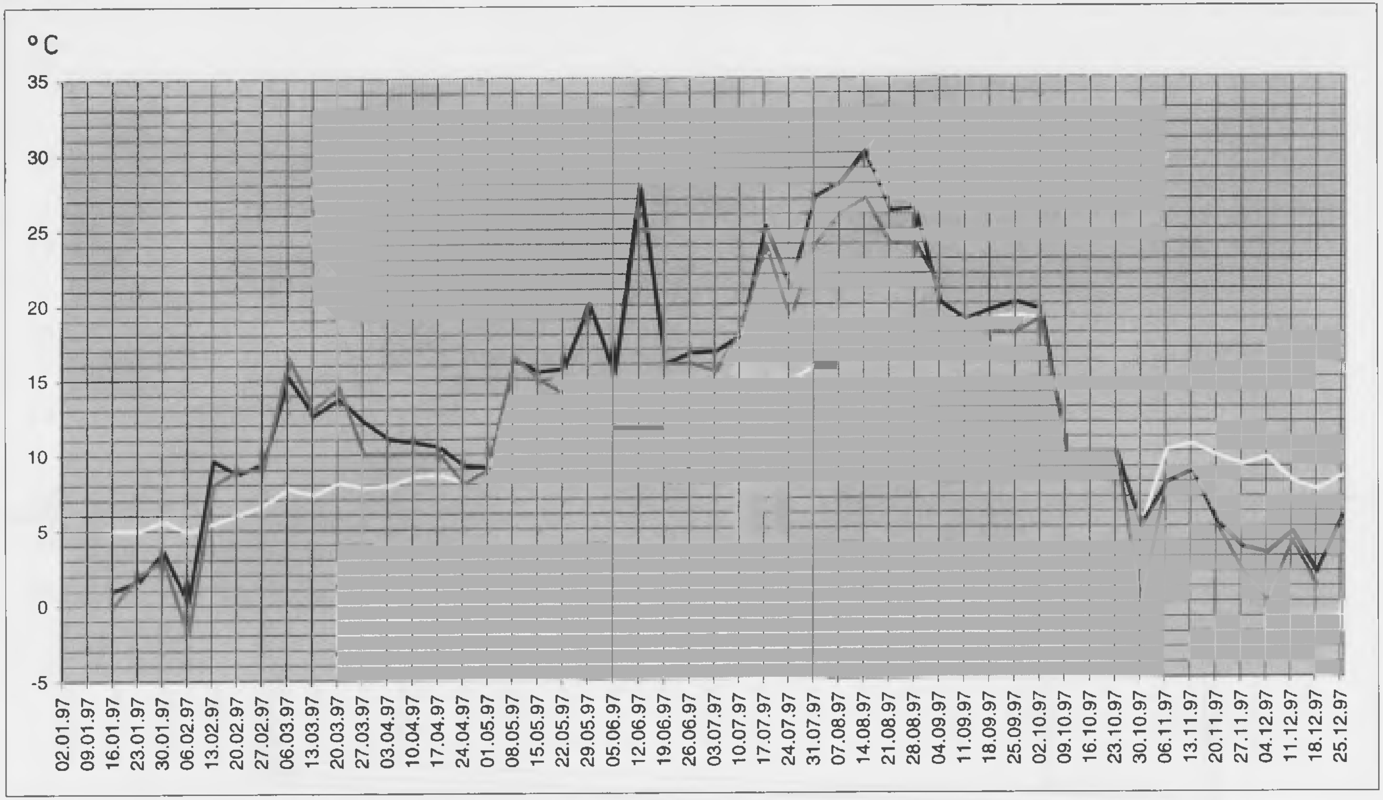


Fig. 8 : Mosaïque 9. Cycle annuel 1997 de la température dans l'abri (noir), à l'extérieur (gris) et sur la mosaïque isolée (blanc).

SESSION 4

TREATMENT OF *IN SITU* MOSAICS

Roberto Nardi

The treatment of mosaics *in situ*

A review of the methods used in treating mosaics must proceed hand in hand with an analysis of their historical meaning. Technical solutions have always been the result of cultural choices influenced by a prevalent attitude that has seen them as simply "aesthetic" objects, and thus detachable from their surroundings and capable of being seen as movable artifacts.

The 17th-century "discovery" of archaeological sites and their subsequent transformation into mines for treasure-seekers marked the beginning of a process of demolition that would continue for almost 200 years. During this period, detachment and removal were the favoured options. The sites and their buildings were divested of their most important elements, which were removed to museums, palaces, storage, dealers' shops. The original location of mosaics was not documented and their context was destroyed; information regarding the origins of the objects was not considered important, and mosaics were valued only by the image created by a fine layer of tesserae.

Mosaics were detached in ways that varied from lifting whole blocks that included all the bedding layers, in sizes and shapes determined by the cracks in the mosaic itself, to the cutting of pieces, usually larger than one square metre, done by first securing the exposed tesserae surface with gauze using glues or natural resins. Once lifted from the ground, the bedding layers were removed and the tesserae were re-attached to stone slabs, or mounted on metal or plaster plaques, or even embedded directly onto walls or floors in a new location.

These early approaches evolved as all components of archaeological sites came to be increasingly appreciated. Public interest for the ancient world expanded from the objects in museum to their places of origin. Mosaics continued to be lifted, the layers beneath the tesserae destroyed and surface irregularities flattened out. But floor pieces were occasionally replaced in their original position, on new supports that were fixed or moveable.

Over time, much attention continued to be payed to the tessellatum but a new option for treatment slowly started to emerge: the presentation of mosaics in their original location. Detachment procedures did not change much, although the rolling technique was introduced and the lifting of very small sections at a time was sometimes used.

New fixed supports were introduced, usually consisting of reinforced concrete, and it was even suggested that surface irregularities be reproduced in the new bedding layers.

We are at the second half of the 20th century and this is an important time since solutions that were adopted have had strong implications for the conservation of mosaics. The increasing attention paid to mosaics and specially to archaeological sites generated a growing number of projects and initiatives. These activities brought about new experiences and more and more applications of "modern technologies".

This was the moment of the "inventions" of the restorers; the time of cement, synthetic resins, panels, light panels, heavy panels, and foams. It was particularly a time of "experiments", the results of which we can still only partially assess today. (Many "unsuccessful" experiments can no longer be evaluated since the mosaics, without any documentation, have been lost.)

This is how a restorer of the past works:

- the restorer works alone (or in a group of restorers);
- his attention is focused on a single mosaic at a time;
- his work proceeds day by day, or it is planned on a weekly basis;
- his work is cloaked in secrecy;
- his work ends when the direct treatment of an object is finished.

We can immagine the questions that were considered:

- how do I cut?
- how much will the piece weigh?
- which was the original pattern for the reconstructions?
- how do I clean the tesserae?
- should I use resin No. 345 or No. 2?
- how do I polish the mosaic?
- how can I reassemble the pieces?
- how much will I spend (and what profit will I make)?
- how can I save money?

But parallel with the proliferation of restoration projects, another cultural view was slowly maturing, and a different understanding of history was emerging. Slowly but with certainty, history is being viewed as a dynamic process, stratified through time. Archaeological sites were seen as places where history occurred, where the signs of life have been deposited and preserved in layers. More attention started to be paid to these signs, to what we can call the cultural value of the site. Cities, settlements, buildings and even objects increasingly took on the role of material evidence of a continuous process: the 'place-life'. Attention slowly shifted from the single object - the mosaic - to its context - the room, the building, the site. This new view led to a trend to keep *in situ* all those elements that qualify and identify the site: movable objects stay in the site museums, frescoes and mosaics in their original locations. This approach fostered knowledge about mosaics, and the many components of the ancient structures started to be appreciated. The component materials, the techniques used, and the traces time had left were studied and documented. The principles of minimum intervention started to become policy and to be applied, not just to the aesthetic image of the mosaic, but also to its material substance. An ar-

chaeological mosaic became not only an aesthetic image, but it was seen to have also a physical reality created by its composing materials. Mosaics came to be seen as the result of a technical process or working production technique, and its history, created over centuries of existence.

Increasingly, cultural values started to encompass the study, documentation and respect of all these elements.

From this moment on, methods and techniques for the treatment of mosaics have followed an evolution similar to that of the conservation of frescoes, perhaps with a lag of twenty years. This evolution has taken the conservation of mosaics from regular lifting and re-laying on movable panels, to *in situ* consolidation, with detachment used only in rare cases. A new sensitivity governs the treatments, and techniques are modified according to new principles and methods. Materials and treatments reproduce the original recipes (mortars and the phases of their application), and respect the signs time has left on the mosaics.

The restorer became a conservator, and his task is no longer to transform the mosaic. The traces left by the passing of time are preserved, made evident and passed on.

In situ conservation of mosaics does not refer to the place where the work is treated, and it refers, even less, to whether or not the mosaic is replaced in its original position. *In situ* conservation means respecting and preserving all the cultural values of the monument, including the historical, technical and material ones. The mosaic is kept in its original position within a distinct structural system: the layers that make up a floor are saved; the signs, or scars, left by time — the changes, the tampering, the irregularities — are studied, interpreted, preserved and made understandable to the public; the physical materials are not altered through the use of extraneous and incompatible products. The intervention does not depend upon "miracle cures", unrelated to the original methods that created the piece.

The process of conserving mosaics *in situ* consists of several steps, namely, documentation and study; actual treatment of mosaics; and other steps taken for protection. The importance given to any of these steps depends upon the kind of mosaic that it is being considered, its state of conservation and, above all, on the time elapsed between the excavation and the treatment.

In order to better understand here the methods and purposes of the direct treatment of mosaics, their actual composition and the mechanics of their erosion/disintegration must be looked at.

A mosaic is placed on a series of superimposed layers (generally four) made of mortars based on lime and various aggregates. The layer of tesserae is applied to the most superficial preparation layer.

Tesserae can be made of different sized pieces of inorganic material, mainly stone, but also vitreous paste and ceramic.

Deterioration can occur in any of these layers, due to pulverization of mortars, to creation of hollows and to loss of adhesion among the elements. Hollow spaces can be found, then, between the preparatory layers and in depth. Mortar can be lost between the tesserae, and hollows can be found between the tesserae and the bedding layer.

Finally, tesserae can be lost leaving the way open for the subsequent development of lacunae.

All of this can be caused by tampering due to re-utilization, collapse of the surrounding structures, fire, vandalism, theft, sinking of the foundation layer, plant growth, wrong utilization during the modern era, and the natural disintegration of the materials used.

Direct treatment must find a remedy for all this. After which, preventing the occurrance of the same damaging conditions will be the purpose of subsequent indirect interventions. Adhesion, continuity and compactness among all the layers of the mosaic must be recreated through direct treatment. It must be accomplished without including elements extraneous to the original structure, since they could prove to be unstable or might not bond with the original, and therefore be rejected. For this reason, great attention is dedicated to the study of the original components. The only materials that can promise durability and assimilation are those similar to the original ones.

For the last 15 years, research and on-site practice has moved ahead in this field: to perfect the combination between binder and filler in lime-based mortars, to refine application methods.

In the actual practice: to discover and to define the area to be treated, to combine the correct components in the mortar and to blend them, to clean and prepare the areas to be reinforced and to apply consolidants, the stabilize, to reinforce both in depth and on the surface, to treat edges and lacunae, to evaluate the results.

Parallel to the new ethics, the technical ability to keep the mosaic *in situ*, with total respect for the work and its archaeological context, is growing. With regard to conservation problems, the principle of going beyond the mosaic and analysing its surroundings, taking them as a whole together with a larger environment, has also acquired importance. Problems are considered within a broader scope, with the objective of preventing further damage rather than reversing that which has already occurred.

From dedicating the greatest care to the tessellatum while destroying its context, as was the case in the 1800s (and in some instances even today), we have shifted to minimum intervention on the tesserae layer and concentrating instead on context and surroundings. Whereas once the mosaic was treated in a single intervention, we are focusing instead on preventive, long term care, and depending upon maintenance for the preservation of the work in the future.

A number of activities that do not touch the mosaic itself have become part of the tools available to the conservator. Water drainage, roofing, seasonal covers, back filling, protection from animals and vandals, suggestions and solutions for a proper use of the site, testing, creation of information systems, training courses for local operators and tourist guides, are all within the concern of the conservator. The conservator must recover the mosaic and must at the same time determine the conditions for its future active and passive protection, safeguard and maintenance. This means that potential risks must be anticipated in order to set up precautionary protection intended to curtail, if not altogether avoid, direct interventions on the mosaic in the future.

Herein lies the greatest transformation in the professional responsibilities of the conservator:

- attention is no longer focused singly on the mosaic, but encompasses the surrounding structure;
- work does not proceed day by day;
- work is planned not on a weekly basis but with a horizon of years;
- a conservator no more works in isolation, but is part of a team made up of various professionals;
- work is not carried out in secrecy and great attention is given to informing the public;
- a conservator's work does not end with the restoration of a mosaic but it carries on through maintenance and protection.

Some of the questions corservators consider today are:

- what are the priorities of the work?
- how can we minimize risks of further deterioration?
- what programme are we following?
- what resources and funds are available?
- what is the objective of our work?
- what are the steps to be followed and what is their schedule?
- how do we plan future maintenance?
- which part of the structures will be backfilled?
- how can the documentation be designed so that it is easy to use?
- how can we inform the public?

These indirect actions share the common characteristic of being highly effective and with low cost, even without considering the added benefit of prevented damage. The exact opposite is true of direct treatment, where costs are usually very high and benefit low.

Indirect actions can have excellent results in terms of preventing further damage, but they must be planned and this planning requires a considerable investment in terms of attention. Indirect actions are preventive and must be implemented before damage occurs. They cannot be considered a form of treatment of existing damage. They should be considered a form of insurance.

In pratical terms, everything that has been said points to the need to broaden the range of action of the traditional restorer/conservator. This new professional must be prepared to consider, together with the direct treatment of the mosaic, also the surrounding elements that can change the environment. With this new vision, intervention will lead to the conservation of the mosaic as well as to the planning of its future active and passive protection. But if this new vision is to succeed a change must also take place in the attitude of institutions and teachers when planning courses for the new generations of professionals. We need more courses on prevention, management, archaeology, communication, together with restoration techniques.

Mosaic conservation can no longer consist of only direct interventions and treatments. It has come to be seen as a combination and interaction between direct and indirect activities, implemented according to precise theoretical methodologies. Mosaics are part of the archaeological record and they have to be considered in that context.

Direct treatment must be developed in the context of future plans for maintenance and protection. The significance of the archaeological context and the mosaics must be made evident, in order to live rather than to be fossilized. As in ancient times, mosaics will survive if they have value and significance. The difference is that today, this significance will not be their function as flooring in residential, religious, or administrative structures. Their present significance is their cultural value, embodied in the historical message and its communication within the context of the archaeological site.

This cannot be the result of improvisation but it is something that will be achieved through a global view and an active management of the archaeological site.

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DISCUSSION

de Guichen: [trans.] There is a newspaper in France called *Le Figaro* which says that the weight of words shocks. If I were the editor of *Le Figaro* I would ask Dr. Nardi to be a member of my team. He asks us to change our attitudes, and the next generation will have to be prepared for this change of attitudes. This is what we call preventive conservation in museums; we should not think only in terms of mosaics but in terms of a site. We must not think in terms of individuals but in terms of teams. We should indulge in long-term rather than short-term thinking. We should not think in terms of immediate costs but in terms of investment and, last but not least, we must not think of how, but why? Can I take it that some of you felt provoked?

Melucco Vaccaro: I think we should take Roberto Nardi's presentation as our guidelines. Perhaps it is necessary to stress one present risk: nowadays everybody, local communities and tourist operators have learnt the lesson; they know that when something is found on a site it is much better for it to stay *in situ* because it enhances the site. But sometimes there can be the odd case where not all the conditions for leaving the mosaic *in situ* are present. The conservator and perhaps the archaeologist may be under pressure to preserve *in situ.* I think that it requires an enhancement in our capacity to communicate with society, with the local powers, to make completely clear to them the responsibility that they are taking on their shoulders and what conditions must be fulfilled if they choose to leave the mosaic *in situ* just to make an archaeological site for cultural purposes. They must strike the best balance possible between how they use the resources and their own interests. Sometimes we are, therefore, obliged or we are forced to maintain remains *in situ* when the necessary conditions are not ensured; this entails more work since the achievement of our aims will be more difficult. That is my personal experience which you may or may not share.

de Guichen: Thank you for that warning. A change is required in the mentality of the profession, but also a change in the mentality of the administration, and we have to work on this. This committee should probably not just try to follow this evolution but to control it. As I said, our thinking should be long-term, not short-term.

Chantriaux-Vicard: [trans.] Regarding the change in attitudes and mentalities which we heard about with reference to the example of the mosaics in Jordan, we have seen that lifting the mosaics is not systematic and that two different types of intervention may be defined; one comprises the reburial of those mosaics which can be maintained on their original support and the other the lifting of those mosaics which have to be moved for obvious reasons of deterioration, or for the retrieval of data. In one case it was possible to see that after three years the deterioration process made it necessary to intervene very quickly. This shows that a change in attitudes has been triggered. I was surprised, however, to see photos of restoration which made some people laugh. I do not see why people should laugh when they see a grinding tool used for grinding or smoothing. Errors in the past were smoothing which removed the information from the surface of the tessellatum. Another major area was the lack of an intervention layer. But when I see this tool I do not laugh because in some cases we do have to use one. When you restore mosaics which have been reset on cement, you have to use this tool. Perhaps I should not really comment on this photo because there were photos showing the wrong sort of intervention and other photos where we could not see what it was. Our former restoration techniques are part of the history of mosaics. The role of the restorer is to ensure the physical safeguard of the work, preserving traces of its history and making them intelligible. After the restoration of a mosaic at the beginning of this century, you are not going to de-restore the parts which have been done by mosaicists who had a different ethic. You have to respect former techniques, even if they are liable to be criticized, to be improved upon.

Weidmann: [trans.] Roberto Nardi made a comment which I felt was very good, about a change in mentalities. He showed the conservator as a murderer with his knife. In Gaël de Guichen's presentation with the preamble, why should the first question be: will the site be destroyed or not? The first question to ask should be: does the site contain a mosaic? The mosaic may rescue the site — why not have that sort of approach? Are we not victims of the achievements of the past? If we could not lift mosaics, perhaps we could have defended them better *in situ.* I think a mosaic is the eye of a site. If it is lifted, what is left? Perhaps we should remember the chance it gives us to focus the data. If you have a mosaic at some point in time, you can say it is exceptional; let us try and change our plans. But I did not go any further, but you could go further into the details. When you discover a mosaic, you have to choose whether the site will be destroyed or preserved. Will having a mosaic change the plans? I have tried to think of all those of you who talk about emergency excavations. You know the bulldozers are there, and the mosaic may be destroyed within a few days. We can go further with our way of reasoning.

Anastassiades: [trans.] First of all, I must congratulate Dr. Nardi because he dealt with the whole business of treatment with humour and not as if it is a criminal offence. He also spoke about teams; this is the fight that we all fight, to work as a team. And people regard us as mere technicians and not as scientists, which we are.

Menicou: [trans.] I would like to talk about the word 'public', which has been mentioned by various speakers. What public are we addressing? Just the tourist public, just archaeologists, specialized people? Who is this public? People who are sitting around a table, or the old people whose houses are next to the archaeological site? They sleep on the mosaics; their houses are built on or around them. And if the mosaic is removed, this old man could sell it to a European and get some money. I want to know what public we are talking about. What is our public and how will we get in contact with this public?

Nardi: I think this public is professional, unprofessional, interested, not interested. Obviously it is easy to deal with a public that is educated or already interested in archaeological sites or in culture. But this also gives an opening to us, an indication that we have to concentrate. It is a paradox, but we almost have to concentrate on everybody who is not interested today more than everybody who is interested, because those who are interested are already on our side. That is the reason for pushing so much in organizing initiatives for children, because children are today the public of tomorrow, including those who might not have been the public of tomorrow. As you see, we have to work at different levels, in different steps. But the objective is always the same, to sensitize everybody to the theme of the importance of cultural property.

Kakoulli: We all know that planning, management and documentation lead us to the programme of conservation, which I believe should be based on the minimum in-

tervention, and that is what Dr. Nardi showed. We should all aim for longterm maintenance when we want to preserve the site and the mosaics with direct treatment, but I would like to ask you how much respect there is for the retreatment of monuments once they have been treated; based on minimum intervention, some allowance should be made for further treatments in the future because monuments are not restored to be there for ever. But they should definitely allow further treatments in the future and further maintenance if necessary. And the other thing I want to mention is respect for the physical history of the monument as well. We all know the ethics involved, but we saw, as Stephania (Chlouveraki) mentioned earlier, a case where the mosaic had been flattened, and she mentioned the preference of the director of the local authorities concerning the exhibition of the monument. So, is that a matter of preference or a matter of ethics?

Nardi: Those are not easy questions. To answer your second question, a good example is provided by marble and other stone monuments with traces of monochrome layers on their surfaces. In former times, until ten years ago, these were considered to be the result of decay of the stone or simply dirt, and they were removed. The stone monuments were rendered white, shiny and beautiful, as they never had been before. Then somebody discovered that those traces might have been the result of maintenance treatments of the original times or of Mediaeval or 16th century date. It was also discovered that those layers, those coatings, were protecting the stone. Those layers are not removed any more, and sometimes they are replaced because they are definitely consolidating and protecting the marble. I think this is an interesting interchange between archaeology and conservation. At this point, our action as conservators has been directed by the stratigraphy and by the archaeological investigation.

Ben Abed: [trans.] I was very interested in your presentation. I was rather surprised by your optimism; it is marvellous, fantastic. You are talking about a change, an actual change in attitudes, mentalities and in practices, but I have a feeling we are living in two different worlds; I can see the change in this sort of conference, but when I look at the actual world, I cannot see it very much. You say that the problem of cement has been solved, but I know of countries where they still go on using it. You say that we must be in favour of, must promote *in situ* mosaics, but preserving them, conserving them, there is a problem there. I think this is far beyond us as professionals. It is a political problem, and as long as we, in this sort of assembly, do not set up a league for the preservation of mosaics, we do not send telegrammes, we do not try to shock people, to shock the decision makers, governments and heads of departments, we will not succeed. We must shower them with telegrammes and things to say: "stop, you are criminals." If this sort of assembly does not lead us to that form of action, I will be very disappointed.

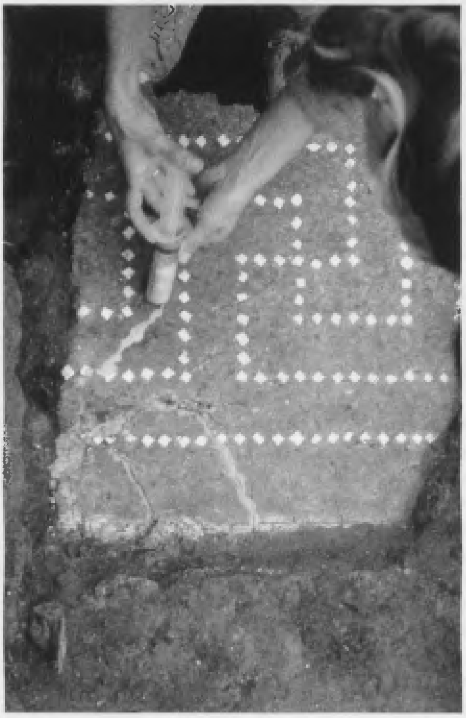
Nardi: We say that donkeys are optimists. Well, I am a donkey. Let me answer you as a private contractor. Fifteen years ago, no administration in Italy was interested in

paying for documentation. So, we started to work without payment on the documentation, and after two years they asked us for all the documentation that we had produced. And they paid for it. And now documentation is normally paid for in any intervention. In the last two years, our company treated, on site, one thousand square metres of polychrome mosaics. It is not too much, but it is just the beginning. In 1990, we started a programme in Israel, thanks to Giora (Solar), a programme of training local people in conserving mosaics and frescoes *in situ* using traditional techniques. After five or six years in Israel it is normal, it is routine to conserve mosaics *in situ*, and cements have disappeared. Lifting is only used in special circumstances. I don't know if this means that I am being optimistic. I think that it means I am being practical and I can produce examples. The more examples we can produce the easier it will be for our colleagues to exert pressure in our direction. It will only be a matter of time. Maybe some country will be able to experience the same route five years later. But there is no rush; we have time.



Fig. 1: Documentation.
Documentation is today an operation universally accepted and implemented. More than the technique used, it is important that a common language be used to describe the various features of the monument. Nevertheless, it is important to stress that documentation is not simply registration of data: it is first of all an instrument for the study and understanding of the mechanisms of decay, that is essential for planning the corrective measures (on structures and floors) to be carried out in preventive conservation. Documentation is one of the first operations to carry out on-site: each mark on the mosaic's surface should be classified and represented graphically. The process starts by entering the state of conservation (type of decay) of the mosaic, details of the original techniques of making the mosaic (sinopia, *giornate*, retouchings), of the historic life of the building (uses, restorations, collapse). Documentation continues throughout the intervention, entering the operations carried out and the areas treated and will go on throughout maintenance. Photo CCA (Centro di Conservazione Archeologica).



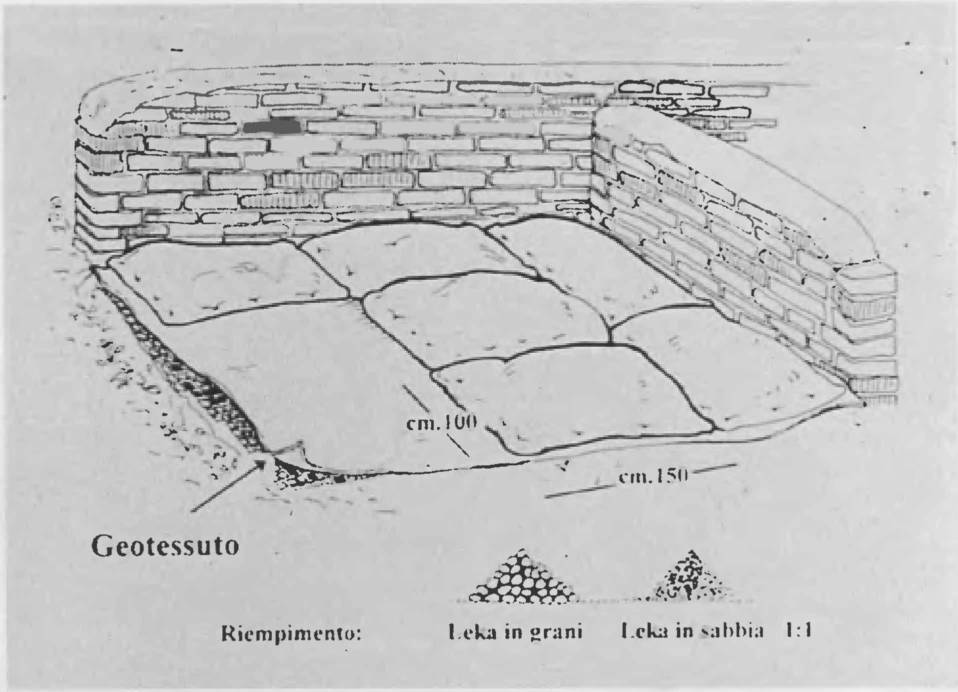


Figs 2 and 3: *In situ* conservation.
In situ conservation of mosaics does not refer to the place where the work is treated, and it refers, even less, to whether or not the mosaic is replaced in its original position. *In situ* conservation means respecting and preserving all the cultural values of the monument, including the historical, technical and material ones. The mosaic is kept in its original position within a distinct structural system: the layers that make up a floor are saved; the signs, or scars, left by time — the changes, the tampering, the irregularities — are studied, interpreted, preserved and made understandable to the public; the physical materials are not altered through the use of extraneous and incompatible products. The intervention does not depend upon "miracle cures", unrelated to the original methods that created the piece.

Few years have passed since the ICCM fostered discussion regarding the steps to be taken for *in situ* consolidation of mosaics versus automatic detachment, and in favour of the use of traditional materials and techniques, as opposed to cement and synthetic resins. The years are so few, in fact, that it is surprising to see how much progress has been made. Photos CCA.



Fig. 4: Informing the public.
Conservation *in situ* is a great opportunity to inform the public about safeguarding the cultural heritage. Similar initiatives are the organized openings of the work-site to visitors and supplying at the same time information posters, updated briefings for tourist guides, lectures and guided tours. The relationship with the public must be active, it must be managed rather than endured; the public must be made to feel welcome by didactic aids or guided tours. All these contribute to turning the technical intervention into a cultural event, and creating greater sensitivity among the public. These initiatives usually meet with great public success and achieve considerable media attention. All these elements create understanding and greatly support conservation. Photo CCA.


cm.100
cm.150
Geotessuto
Riempimento:
Leka in grani
Leka in sabbia 1:1





Figs 5, 6 and 7: Preventive measures of protection and maintenance.
Conservation *in situ* does not end with the intervention itself but must continue through the years with constant maintenance. We can say that a conservation programme's success is measurable in the future maintenance of today's results. The best way to ensure that maintenance will continue is to make it financially viable. This means minimal present costs, maximum future savings. To achieve this the resources found in the field must be used and maintenance must be immediately linked to the conservation intervention. Maintenance will be organized in different parallel phases: preventive measures of protection, direct treatment of the mosaic and control.

The worksite must be organized with marked paths, information, observation points, temporary covers (seasonal), roofs, and whatever would facilitate an intelligent visit and at the same time an easy (and safe) maintenance of the monument. Photos CCA.





Figs 8 and 9: Training and up-grading conservators.
Conservation *in situ* could be intended as a "new discipline" in the "modern" approach of conservation. Sometimes this is true, sometimes not. Most of the time this is simply a different way of applying already known techniques and materials. In any case it is extremely important to insist on the needs of implementing training courses focused on this field. Those courses will deal with techniques for maintenance, temporary and preventive measures of protection, documentation, cleaning, consolidation using lime-based mortars, traditional and local materials and communication, team-working, planning and reporting. Photos CCA.

Jacques Neguer

Conservation of mosaics *in situ* at Tel Itztaba, Bet She'an, Israel

THE CHURCH

The church is situated at Tel Itztaba, not far from the city walls and about 400 m east of the Monastery of the Lady Mary. Few buildings surround the church. To date, a large church, a chapel and a dining hall have been revealed.

The church had a basilica plan — the hall was divided lengthwise by two rows of columns into a nave and two aisles and was tri-apsidal. In the central apse, a synthronon was found. At the front of this apse was a platform paved with *opus sectile*, in the centre of which the altar would have stood. In front of the altar was a marble chancel screen. In the north apse a chancel screen, intricately carved in marble, and a decorated marble sarcophagus were found. A wholly preserved chancel screen was discovered in the south apse.

All the church floors, excluding the raised platform, were furnished with mosaics. Those mosaics in the nave were in beautiful geometric designs. Along the borders were plant motifs (including fruit and vegetables) and panels of hunting scenes where the animals were shown in a realistic, animated style. The rest of the church floors were decorated with geometric patterns.

West of the church was a row of columns that carried a portico used as a narthex. A partially destroyed Greek inscription was found in the mosaic floor attributing the church to a martyr whose name is not preserved. Another chapel, found north-east of the church, had a large apse on its east side. Between the church and the city wall a dining room was revealed, its ceiling supported by columns. Adjacent was a kitchen with cooking facilities and food jars.

Although the identity of the martyr to whom the church was dedicated is unknown, it is possible to identify the complex with the episcopal palace and the church of the Martyr Procopius — a man of Beit She'an who was executed in the year 303 AD. According to the writer Cyril (Cyrillos) of Scythopolis, the palace and church were within the boundaries of the city.

The church continued to function as a Christian centre after the Arab conquest, with few changes and additions. The monastery was ruined in the earthquake of 749 AD.

THE GENERAL CONDITION OF THE MOSAICS AND CAUSES OF THEIR DETERIORATION

Several types of damage and deterioration can be seen on the site. The bedding layers suffer from deterioration and crumbling. Advanced deterioration is seen mainly in the *nucleus* and the *rudus*, which is detached and crumbling over a large area. The *statumen* and the lime bed are generally in good condition. In places where the tessellatum begins to crumble, deterioration is slow and is seen to begin from the centre.

The floor was cleaned with a large quantity of water after the excavations. The resulting water penetration encouraged salt migration, which prompted detachment from the bedding layer. In many places the floor is detached from the bedding layer and is protruding, with voids underneath. In the central nave of the church, these voids have a diameter of up to 3 m, although surprisingly, the floor has not deteriorated there. The voids are due to salt penetration and movement between the tesserae, with accompanied water evaporation from the floor. Salt accumulation between the constructive layers (lime bed and *nucleus, rudus* and *statumen*) causes them to move further apart and a general expansion of the floor results in displacement between the constructive layers. In Tel Itztaba, the floor expanded by a few centimetres. Since there was not enough additional space available for the floor to expand, protrusions and depressions were created and in many places the floor is detached from the bedding. These protrusions appear in various forms: half spheres, snake-like forms and others. The protrusions existed in the floor before the archaeological excavations. During the excavation the release of the floor from the mass of earth over it enabled the protrusions to grow larger. This phenomenon could be observed as the conservators were working on the site. Besides the above-mentioned salt effects, new efflorescense can be seen in some spots. A hard salt layer, about 0.5 cm thick, covers the mosaic surface. The local earth is highly saline, the sulfate concentration being about 400 mg./l., while in the mortar it is about 120 mg./l. Ground water may be found at a depth of about 50 cm.

The mosaic surface is cracked, and in many places irregular. Red tesserae are protruding and in a state of extensive crumbling and exfoliation. Scratches can be seen all over the mosaic, a result of hard mechanical cleaning during the excavation. The sad results of using a large quantity of water to clean the floor are mentioned above; and, finally, the free movement of people and cattle over the site is an additional cause for physical damage and has contributed to the floor's detachment from the bedding layer.

CONSERVATION WORK

To study the possibilities of conservation, a one-month research and recording project was carried out, which included recording the as-found physical condition, testing conservation techniques (*nucleus* consolidation, *statumen* consolidation, bitumen stone consolidation, wall consolidation, plaster consolidation, and surface cleaning), photographic recording, laboratory testing (chemical analysis) and the recording of modern interventions.

After analysis of the results and of the conservation techniques used, a conservation programme was presented to the Israel Antiquities Authority. The long-term conservation

programme involves a drainage project, a roofing project, an anastylosis project, a mosaics conservation project, a conservation project for walls, plasters and architectural elements, an integration and restoration project and a maintenance and protection project.

The physical condition of the mosaics determined the priorities for intervention and the possibilities for access and protection. A roof was built over the area not included in the first stage of the project. A walkway was marked over a special plan. The covering and protection of the site were planned after every season, including herbicides and fire prevention treatments.

CONSERVATION TECHNOLOGIES AND TECHNIQUES

Structural Consolidation

Border consolidation was achieved using lime mortars with hydraulic aggregates, ceramic powder and tuff. At first, big lacunae were left open and only the *statumen* layer was consolidated with lime mortar. Although this was nice to see and didactic, the large lacunae were a place for the accumulation of dirt and water. Consequently it was decided to fill them with a very porous lime-mortar (large ceramic aggregates).

The classical grouting formula was changed because of the very quick setting of the mortar in local conditions and the extremely large volume required for grouting (the largest area alone has a volume of 500 litres). To control the setting, the quantity of slaked lime was increased to 75% (from 50%-50% to 25%-75%), and the second mortar was given the highest granulometry (up to 2 mm) compared to the first mortar, whose granulometry was only up to 50 m (see Fig. 1 for the technology).

A vibrator of the kind found in dental laboratories was used. The use of tubes (diameter ~ 5-10 cm) prevented the formation of air bubbles by ensuring a constant pressure in the whole volume. For protection during the work, velatino was used and cleaned quickly after the operation. The consolidated area was covered with sand bags while the mortar set.

An AB-57 compress, mechanical cleaning with pneumatic tools and nylon brushes were used for surface cleaning. The chemical reaction between the sulfates and the AB-57 is evident: in the cleaned areas no formation of crust is visible.

The treated area was covered with a thin layer of sepiolite to facilitate salt extraction during the rainy season. For long-term maintenance of the sepiolite on the mosaic surface, a fine interglass net was used.

Before grouting, the Barium method was applied for consolidation in areas with large hollow spaces. $(NH4)_2\ CO_3$ was added to the cleaning water and after neutralization $Ba(OH)_3$ was added. The process was under permanent pH control.

RECORDING

Prior to the work, a full graphic documentation of the physical condition of the mosaic, walls and plasters was conducted. Photo-recording was done before and during the work, and rectified photography was used at the end of the work season (see Figs 2-3).

RESEARCH

A full salt testing of the area, the earth and the building materials was carried out. Currently under way are a comparative salt testing of materials before and during treatment, a petrographic and mineralogical investigation and monitoring of the modern intervention.

RESULTS AND OBSERVATIONS

The condition of the treated part of the mosaics (about 200 m^2) is very good: the consolidated part is stable. There is no new salt crust formation in the cleaned area. Decay under the new roof has slowed down. The untreated part still needs intervention, but to date there is no budget for this. Unfortunately, covering as the sole means of treatment does not resolve the problems because of the presence of sulfate salts.

ACKNOWLEDGEMENTS

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DISCUSSION

Corfield: I might have missed it in your presentation, but how did you prevent these very high salt concentrations in the soil from coming back into the site?

Neguer: By three means, drainage around the site, roofing, which is not yet ready, and the treatment with AB 57 and Barium method consolidation. The Barium hydroxide worked with the half-soluble sulfates and transformed them into non-soluble sulfates. But the crucial thing is to clean the surface. The process is the formation of crust, closing of the surface, and after this is the growing up.

Barrow(?): I think your project is very thorough. Is the testing carried out prior to treatment done for the idea of evaluating the treatments in the long term future, or can you comment on how you intend to evaluate the effectiveness of the treatment in the future and in a scientific manner?

Neguer: First of all, before the research, salt testing, there was a theory why this happened. And one of the possibilities was the formation of half-soluble sulfates, and hydrocrystallic forms of these sulfates. But after this, this theory was not diagnostic. Now, I take samples from the mortars, not only from the original bedding layer, and from

every material used for cleaning and consolidation of the mosaic. And every year I do the salt testing and the comparison between the different materials. Inside the sepiolite layer, after the cleaning at the end of the winter season, I check the quantity of sulfates inside the mortar closing the lacunae. There is now a very high percentage of sulfates. This means this is a pump for sulfates, and the sulfates do not go inside the mosaic to crystallize but they go into the intervention mortar. And this mortar can be changed in some hours without any problem. But that is not everything. I want to check also in depth the grouting and formation of the silicates and carbonates and barium sulfates inside the mortar. But for that I do not have enough samples; the time is very short.

Fontanelli: [trans.] He underlines the importance of having a conservator on the team during the course of an excavation. The conservator can intervene immediately, but if there is no conservator present, those specimens of the past could be destroyed. The second point is the question of some of the tesserae which are vitreous tesserae; they are fragile and with a change of chemical condition, they can break, making the whole mosaic unsound.

Neguer: At this time the conservator of mosaics in Israel was Roberto Nardi. One year after the project at Tel Itztaba, the people from Tel Itztaba were working on the major project of Beth She'an with ten thousand square metres of mosaics *in situ*. This was the time in which the deterioration took place. There was no law at the time requiring a conservation team in Israel to carry out the preservation work together with the archaeologists. Now this is a policy; this is the law. But two, four, six years ago, everything was different.

de Guichen: Things have changed, I understand. I have one further question. You were telling us that you cannot maintain the site because of lack of money. What is the cost of maintaining such a site open to visitors and what does it cost to maintain this site covered as it is?

Neguer: Everything was calculated during the first stage of the project. It was a one month project with eight people from different institutions to undertake the management and conservation. With regard to the full project, there is no road going to Tel Itztaba and the infrastructure does not exist so the costs run to half a million dollars. The necessary conservation work is around two hundred thousand dollars. I have used half of this money for all the work necessary for the conservation, including the two roofs. This is not a permanent roofing; it is provisional, but adequate, and does not cost so much. For a hundred square metres, the cost is six thousand dollars, and the roof is pleasant, usable and it works. One part of the drainage system has now been completed. To maintain the site in the present situation I need five thousand dollars every year. For the covering of all of the site, for reburial, I need around twenty five thousand dollars. But that is not a solution to the problem. Without treatment of the site, the reburial does not resolve the problem.

de Guichen: I think it will be interesting in the future for this committee if such figures are presented within interventions so that they know what we have done and what it cost, also to have some idea of how much it cost in time, equipment and materials. Of course, human time does not cost the same in one country as in another. It will change. But it will be of interest to know that it will cost so many man-hours to maintain one square metre in clean condition. I think it could be important if we can manage to start to work this way. Otherwise we keep on saying that it costs a lot of money, and we have no money. This does not expedite matters.

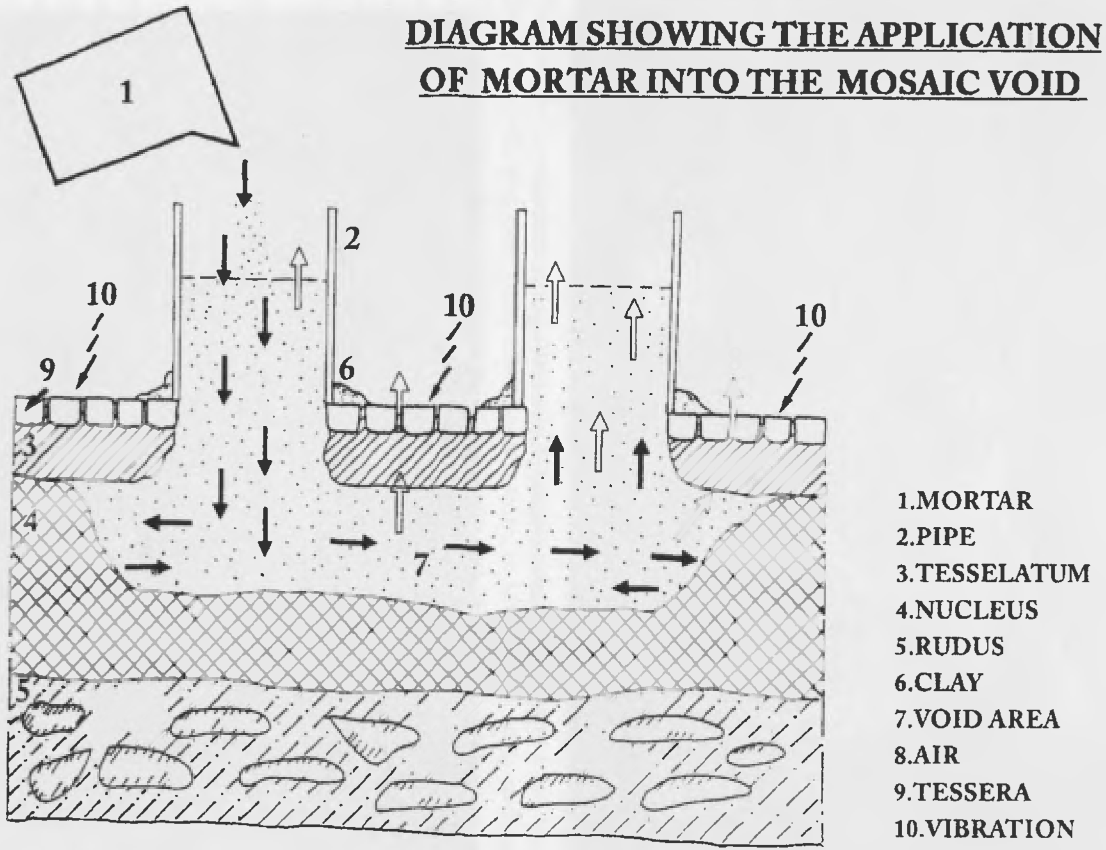


Fig. 1: Diagram showing the application of mortar to the mosaic void.



Fig. 2: Tel Itztaba, rectified photorecording of the mosaics.



Fig. 3: Tel Itztaba, rectified photorecording of the mosaics.

Thomas C. Roby

In situ stabilization during excavation of Roman floor mosaics severely damaged by root growth and their condition after temporary reburial

INTRODUCTION

Given the acceptance of the conservation principle of minimum intervention and the rejection of detachment as a normal treatment technique in other fields of conservation, such as wall paintings, the published examples of *in situ* floor mosaic conservation remain surprisingly few in comparison to lifting treatments. By requesting papers concerned only with *in situ* conservation, the conference seeks to remedy this situation, while addressing both the theoretical concepts behind an *in situ* approach, and the technical methods available to it.

Despite the recent movement towards an *in situ* approach in the field of mosaic conservation, the conservator today must still resist considerable pressure from archaeologists, developers, and even from other conservators, to lift mosaics from archaeological sites. The reasons given for lifting mosaics are many and varied, and often depend on the particular circumstances of the mosaic and the preservation threats to the site. One of the frequently used justifications in the past for detaching mosaics has been that their poor condition made it necessary. Tree and plant root growth is a common, yet serious, conservation problem for mosaics on many archaeological sites and it is one that needs to be addressed convincingly by those advocating *in situ* conservation without detachment.

IN SITU STABILIZATION

The excavation by the American Academy in Rome of an atrium-plan house (Atrium V) located adjacent to the Forum of the Republican Roman colony of Cosa in Tuscany during 1995-97 uncovered two mosaic pavements damaged by olive tree roots. The growth of the roots over several centuries had caused the almost total detachment of one of the mosaics from its bedding layers, and the subsequent filling in of voids below the tessellatum with soil and smaller plant roots (Fig. 1). Due to limited time and funding, the conservator was left with the task of carrying out temporary first-aid treatments to stabilize the detached areas and only initiating root removal before having to rebury the mosaics at the end of each season. This regrettable lack of planning did, however, provide the opportunity to assess the emergency stabilization measures after being reburied for both one and two years.

The first-aid treatments carried out in 1995 and 1996 consisted of removing soil and small roots from lacunae and along broken edges and then carrying out edging repairs with a lime mortar (1:2 lime putty: river sand by volume). Under raised sections of the tessellatum, a commercial hydraulic grout mixture (PLM SM), indicated for use on mosaics, was injected in an attempt to fill voids despite the presence of soil and roots (Fig. 2). The inability to remove soil present under a detached tessera layer clearly limits the consolidating effect of a grouting operation. However, an inspection of the grouted areas revealed very little new damage after both one and two years of reburial. In contrast, raised areas due to root growth which were not grouted upon excavation did show evidence of further cracking and partial, localized collapse of the tessellatum when the soil reburial was removed. This damage was apparently due to the creation of voids under the tessellatum caused by shrinkage of the soil after the mosaic's initial exposure and drying out, as well as to the presence of ants which removed soil to build nests, combined with the weight of the soil backfill placed over it. This experience indicates that prior to reburial of a mosaic, whether short or long-term, as much soil as possible should be removed from the mosaic, and grouting and edging treatments should be carried out in areas of detachment in order to supply needed support to the tessellatum.

TREATMENT OF ROOTS

The long-term solution to the presence of roots under mosaics is clearly their removal. Once cut from the main tree trunk, it is possible that a root will continue to grow, depending on the species, particularly if reburied. The continued growth of a cut olive tree root under the tessellatum of one of the two mosaics at Cosa was in fact observed after two years of reburial. On the other hand, if a cut root does subsequently die, it will gradually decompose, thereby increasing the chance of a future collapse of the overlying tessellatum, unless a way can be found to consolidate and preserve the dead root [1].

At Cosa, the removal of olive tree roots situated immediately over the mosaic surface has been carried out with a pruning saw or scalpel, depending on their size. Where the root segments were situated under the tessellatum, their removal was begun with a temporary facing of the overlaying mosaic using cotton gauze and Paraloid B72 (15% in acetone). Once faced, the tessellatum was cut with a cutter blade (Stanley) without removing a row of tesserae, following existing cracks and lacunae above the root as much as possible. The tessellatum was then temporarily raised and supported by a thin section of plywood while the root and surrounding soil was removed (Fig. 3). After cleaning the original bedding underneath with water, a new bedding, consisting of hydraulic lime (Lafarge) and river sand (1:3 by volume), was laid. Then the lifted section was lowered down and reset on the still-wet bedding mortar with the aid of stone weights placed on the tes-

[1] M. Demas, N. Agnew, S. Waane, J. Podany, A. Bass and D. Kamamba, "Preservation of the Laetoli Hominid Trackway in Tanzania", *Archaeological Conservation and its Consequences; Preprints of the Copenhagen Congress*, IIC, London 1996, pp. 38-42.

sellatum surface to improve adhesion during setting. Finally, hydraulic grout (PLM SM) was injected underneath the tessellatum to fill in any remaining voids between the tessellatum and the new mortar bedding.

This technique of partial or localized lifting and re-laying of raised but intact sections of mosaic retains the tessellatum's as-found position and deformations, with the new mortar bedding simply replacing the soil and root. To re-lay such a section flat as originally constructed would necessitate the removal of a row or more of tesserae to compensate for the increased surface area of the deformed mosaic. This second option was not followed out of respect for the integrity of the mosaic and the principle of minimum intervention. It should be added, however, that certain cases will arise when it is possible and advisable to relay raised sections of the tessellatum back on a horizontal level without removing tesserae, and examples of such treatments have been previously published[2].

The surgical removal of roots is certainly a valid treatment option when their presence under a mosaic is localized. But where the problem is endemic, such as with the triclinium mosaic from Cosa, one should question whether it is not a more efficient and effective treatment option in the long-term to carry out a general lifting and relaying. As virtually all of the tessellatum of the triclinium mosaic have already been detached by the tree roots, additional damage to the mosaic through lifting would be very small. In addition, a general lifting would permit the complete removal of the layer of soil and small plant root systems currently present under most of the tessellatum.

At present there is no treatment plan to lift and relay the triclinium mosaic at Cosa because there is still no overall conservation plan or project for the future protection, presentation and maintenance of the entire excavated structure. Until such plans and funding are in place, it would not be appropriate to carry out an extensive and irreversible treatment such as a general lifting and relaying. If the site will eventually be preserved by long-term reburial, then the general lifting of the mosaic, in my opinion, cannot be justified, despite the possibility of continued root growth further damaging it. Whether or not the house at Cosa will eventually be presented to the public, the conservation work in progress provides an example of a pragmatic treatment approach, and the appropriate use of both *in situ* stabilization, and where necessary, lifting and relaying techniques.

TEMPORARY REBURIAL BETWEEN SEASONS

Before the end of the first year of excavation, when the two mosaic pavements at Cosa were first uncovered and consolidation treatments begun, recommendations were made to the archaeologists to protect the mosaics between seasons by reburying them using excavation soil over a permeable intervention layer of geotextile, a method indicated

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[2] A.M. Ardovino, "Pavimenti romano-imperiali in opus sectile ed altre tecniche da Suasa: Conservazione *in situ*", *Mosaicos no. 5, Conservacion in situ, Palencia 1990*, Rome 1990, pp. 73-87; T.C. Roby, "Consolidation of a floor mosaic during the excavation of a Byzantine church in Petra, Jordan", *Proceedings of the Vth Conference of the ICCM, Conimbriga 1993*, Conimbriga 1994, pp. 31-37.

at the 1993 ICCM conference[3]. The very fragile condition of the mosaics, due mainly to the damaging growth of the tree roots, required protection primarily from the direct impact of rain, mechanical damage from the uncontrolled presence of visitors, both human and animal, on the site and major moisture and temperature fluctuations. Reburial with soil appeared to be the simplest, most economical way of providing such temporary protection.

The reburial was eventually carried out by the excavation team at the end of the season using a very fine, non-woven synthetic fabric of unknown manufacture, commonly used locally to cover fruit trees in order to protect them from insects. The fabric, not a true geotextile, was then covered with approximately 10 cm of unsieved excavation soil that included stones and roof tile fragments. Due to the fineness and suppleness of the fabric, it closely followed the irregular surface contours of the mosaic, allowing the soil to remain in intimate contact with the mosaic surface — an important characteristic if salt efflorescences are a problem. The fineness of the fabric meant, however, that it tore very easily, as was discovered during the removal of the soil backfill the following year, when many holes were found in the fabric. It seemed that the holes were created during the reburial operation by the stone and ceramic fragments contained in the backfill. When the fabric was removed, an extensive network of small plant root systems was revealed underneath, which had penetrated the fabric from above. The plant roots did not cause damage to the mosaic over the winter, but if the backfill had remained in place for many years they probably would have begun to penetrate the tessellatum. Despite the archaeologists' good intentions, the choice of too fragile a fabric as an intervention layer and the use of unsieved soil in this first reburial attempt produced unsatisfactory results.

Similar problems of plant root penetration of other non-woven synthetic fabrics used in reburial schemes for mosaics have previously been reported[4], although the specific type of material employed, described simply as a geotextile, was unfortunately not indicated. There are many different kinds of synthetic fabrics and geotextiles available commercially in Europe, but not all are suitable for use on archaeological sites. 'Typar' non-woven, spun-bonded, polypropylene geotextiles have been found to be successful in deflecting root growth laterally rather than permitting penetration vertically, and one particular type of 'Typar', style 3401 (Dupont), was recently employed in a many-layered reburial scheme at the Laetoli trackways site, where root growth was a known threat[5].

After the second excavation season at Cosa, the conservator, in the archaeologist's absence, assumed responsibility for the protection of the site and initiated a temporary reburial operation for the entire excavated house, including the two mosaic pavements.

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[3] J. Podany, N. Agnew and M. Demas, "Preservation of excavated mosaics by reburial; evaluation of some traditional and newly developed materials and techniques", *Proceedings of the V^th^ Conference of the ICCM, Conimbriga, 1993*, Conimbriga 1994, pp. 1-19.

[4] R. Petriaggi, "Risultati di un esperimento di protezione di pavimenti in mosaico conservati all'aperto nel sito di Ostia Antica", in *Mosaicos no. 5, Conservacion in situ, Palencia 1990*, Rome 1990, pp. 255-266.

[5] Demas *et al.*, 1996.

The site remains that had been left exposed the previous year, including opus signinum and cocciopesto pavements, showed signs of deterioration, and protective measures needed to be taken immediately. However, given the lack of a budget for site protection between seasons, excavation soil was the only choice for the reburial fill. As a result, a geotextile indicated to be an effective deterrent to root penetration was needed as an intervention layer. 'Typar', style 3407 (Dupont), geotextile was chosen because of its durability in a buried environment, its adequate suppleness and smoothness to follow irregular surfaces without catching on them, and because of its local availability at the time. The geotextile was placed in direct contact with the pavement surfaces as an intervention layer, over which approximately 10 cm of sieved excavation soil was laid, a depth considered to afford the minimum desired protection. An initial contact layer of sand was not placed over the pavements to isolate and regularize their surfaces for reasons of cost, and because this was not considered a necessary layering sequence for a temporary reburial. The cost of the geotextile was about US $1 per square metre, before taxes, and it took approximately four work days to cover the roughly 50 m^2 of the two mosaic pavements with sieved excavation soil.

After two years the reburial was partially removed from one of the mosaic pavements and its condition assessed. Over the previous winters a considerable amount of weed and grass growth had occurred in the reburial soil. Each spring the herbicide 'Round up' was applied to the plants, which was effective in killing them, but during the winter, the plants already had sufficient time to send their root systems deep into the shallow soil fill. When the reburial soil and dead plants were removed, it was observed that the 'Typar' geotextile had performed fairly well as a barrier against roots, much better than the unidentified non-woven fabric used previously, but that it was not entirely successful in blocking all of the root growth (Fig. 4).

The removal of the soil fill also revealed that ants had eaten holes in the geotextile in order to make nests within the mosaic (Fig. 5). The holes were concentrated above an area of lacunae in the mosaic, where the ants preferred to make their nests. This type of damage to the 'Typar' geotextile was unexpected and is probably much more difficult to prevent than root penetration. Filling in of the lacunae with a sand fill below the geotextile could have removed a potentially inviting nesting area for the ants, but it is likely they would have simply nested elsewhere on the mosaic had this been done.

As mentioned above, it was also observed upon removal of the geotextile that where one large section of cut olive tree root remained under the tessellatum, its reburial helped to create an environment conducive to its continued growth. New root growth was visible at the ends of the previously cut root where it entered beneath the tessellatum and both the lime mortar edging repairs and the tessellatum were cracked and displaced due to the root's expansion in size (Fig. 6). This localized damage around the tree root was the only deterioration noted despite the presence of plant roots and ants in contact with the mosaic after two years of reburial. In the near future, if removal of the roots is not possible, the use of a herbicide, such as 'Velpar L', indicated for use by injection into woody roots, will be pursued, as the spray application before reburial to the cut root ends with the herbicide 'Round up', specified for leaf application, was not successful.

After observing the problems associated with the use of a shallow soil fill, other types of fill materials were tried on parts of the building in an attempt to prevent plant roots and burrowing insects from coming into contact with pavement surfaces. An opus signinum pavement was reburied with sand as a contact fill, followed by the same 'Typar' geotextile, then a bulk fill of sand, approximately 10 cm in thickness. After one year it was observed that the amount of plant growth in the sand fill was only a small fraction of that present within the soil fills, but that the several weeds present in the sand fill were still able to send their roots through the geotextile and into contact with the pavement, as occurred with the soil fills. Another experiment on a small area of opus sectile pavement was carried out with sand as a contact fill, then 'Typar' geotextile covered with ceramic pellets ('Valdata') as a bulk fill to a depth of about 20 cm. Ceramic pellets have a long history of use as a reburial material in Italy because they are light in weight, resistant to deterioration, inert and easily obtainable [6]. The sand/'Typar'/ceramic pellet reburial scheme provided the best results after one year in terms of preventing root growth, but far more moisture was found near the surface of the pavement, due presumably to the fact that ceramic pellets do not retain water and therefore are not effective in allowing capillary rise.

Some conclusions or indications can be drawn from the recent temporary reburial experiences at Cosa. Prior to reburial, excavated remains should be cleaned of soil and roots and stabilized as much as possible. Any reburial operation will provide an environment conducive to the continued growth of roots still present in the remains, and to the continued presence or return of burrowing insects, such as ants. The weight of any reburial scheme can also provoke mechanical damage to surfaces of remains if they are not well-adhered to their bedding layers or substrate.

The use of a single layer of 'Typar' geotextile as an intervention layer is not a totally effective barrier against plant root growth from above, nor the ingress of insects, particularly if soil is used as a shallow bulk fill material. In temperate climates such as in Italy, where rapid plant growth occurs throughout most of the year, use of a specialized root prevention material is advised in addition to regular applications of a wide-spectrum herbicide to new plant growth. The use of the 'Biobarrier' (Reemay) geotextile could be an effective component of a reburial strategy, especially in the case of a shallow fill, and if

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[6] R. Nardi, "Couverture provisoire pour les mosaiques que l'on ne peut enlever", in *ICCM Newsletter 5,* 1982, pp. 5-13; P. Mora, "Conservation of excavated intonaco, stucco, and mosaics", *Conservation on Archaeological Excavations, with Particular Reference to the Mediterranean Area.*, Nicholas Stanley-Price (ed.), ICCROM, Rome 1984, pp. 97-107; A. Costanzi Cobau, "The Roman Forum. On-site conservation of floor surfaces during excavation", *Mosaics no. 5, Conservacion in situ, Palencia 1990,* Rome 1990, pp. 127-137; L. Demitry, "Misure preventive di conservazione *in situ* di mosaici pavimentali durante uno scavo di emergenza", *Mosaics no. 5, Conservacion in situ, Palencia 1990,* Rome 1990, pp. 161-171; R. Petriaggi, 1990; A. Martinelli, "Un esperienza di reinterro: la villa marittima di Cala Padovano", *Proceedings of the V^th^ Conference of the ICCM, Conimbriga 1993,* Conimbriga 1994, pp. 21-30; M. Bedello Tata and L. Spada, "Progetto di restauro per il complesso musivo delle Terme dei Cisarii ad Ostia", *Atti del II Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico, Roma, 1994,* I. Brigantini and F. Guidobaldi (eds), Bordighera 1995, pp. 229-234.

the reburial is long-term[7]. In general, a specific type of geotextile should be carefully selected for its specific function within a reburial strategy and for the environmental conditions of the site.

If a contact fill material between the site remains and the geotextile is used, it is advisable to use sand. Many geotextiles will not always be able to conform closely to irregular surfaces, thereby interrupting the capillary continuity between the remains and the reburial fill. At Cosa, the very irregular contours of the root-damaged mosaics would have benefited particularly from such a levelling fill layer. Although no short-term problems related to non-conformity were observed, the existence of a layer of mineral encrustations covering the mosaic surface suggests that, in the case of a long-term reburial, its continued formation could cause the geotextile to become adhered to the layer if the geotextile were placed in direct contact with the mosaic. Sand, however, has been shown to be less effective as a water transport medium than soil, which is important if salt efflorescences are present[8]. Care should be taken in the selection of the sand as well, although most river sands, due to their generally rounded, fine grains and low soluble salt content, should be acceptable. As a bulk fill, sand has been seen to be an effective means of protection, especially in preventing plant growth, but its weight, particularly when wet, could be considered a disadvantage.

Ceramic pellets performed well as a bulk fill material in a situation where their lightness was preferred. No damage to fragile mortar surfaces was observed after removal of the reburial and the pellets were also effective in preventing new plant growth. The observed greater presence of moisture at the bottom of the reburial fill is of concern, however, particularly if freezing temperatures are common in the winter. Laboratory tests have shown that ceramic pellets perform worse than both sand and soil regarding the maintenance of capillary continuity with a substrate such as a mosaic[9], and therefore their use as a contact fill should be avoided.

The use of excavation soil for reburial, while, in theory, being the simplest, most economic way of recreating the stable conditions of the site before excavation, can lead to long-term conservation problems. Soil as a bulk fill will obviously promote the growth of plants and therefore methods of blocking or controlling the growth of their roots will be necessary, particularly if the fill is shallow. Burrowing insects will also be attracted by the soil fill and ways of preventing their ingress will need to be sought. While soil is not discouraged as a temporary reburial material, to be successful it requires regular maintenance, an activity frequently lacking on archaeological sites. If maintenance cannot be ensured, and the greater cost is not an obstacle, then the use of sand as a reburial fill material would be advised.

As more reburial experiences and monitored testing programs are published, we will come closer to defining the advantages and limitations of different reburial strategies for mosaics and other pavements on archaeological sites. There is no single correct method

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[7] Demas *et al.*, 1996.

[8] Podany *et al.*, 1994.

[9] *Ibidem.*

for reburial; there are only appropriate responses to different situations. The choice of materials and reburial sequence must be made in relation to available funds and materials, the type and condition of site remains, the environmental conditions of the site and the length of time required for the protection. In recent years, geotextiles have been increasingly used as an intervention layer in reburial operations. But because of the wide range of geotextiles or similar fabrics available commercially, many different types have been used indiscriminately in blind faith, without knowing whether they are well-suited for the task. There is a pressing need to assess and publish the many different reburial protection treatments of the past ten years, especially those involving different types of geotextiles. Although the recent reburial experiences at Cosa do not provide controlled testing and empirical data on the full range of materials used for reburial, they nonetheless contribute to our awareness of the positive and negative effects of reburial as an *in situ* protection treatment and the relative effectiveness of some of the different materials commonly and currently used for reburial.

SEASONAL PROTECTIVE COVERINGS: AN ALTERNATIVE TO TEMPORARY REBURIAL AND SHELTERS?

Although reburial is a relatively simple means of site protection when compared with the construction of a shelter, it is still a labour-intensive and time-consuming operation and requires some conservation training and maintenance. It also removes the site remains from public view. For these reasons, archaeologists frequently do not find reburial an acceptable method of protection, particularly between excavation seasons. Alternative techniques of temporary protection were sought by the archaeologist at Cosa that could be quickly and easily removed once a year, yet were inexpensive and required little or no maintenance. A sandwich-construction mattress was envisioned, similar in concept to a temporary protection blanket system proposed by Ashurst [10], and to a test recently carried out at Ostia Antica using an unspecified geotextile, stitched together and filled with ceramic pellets and powder ('Leka') [11].

This form of protection is still being pursued for Cosa, but the current lack of maintenance at the site will make any temporary covering system problematic. However, in principle a mattress covering will need to be made of a material resistant to solar radiation, which most geotextiles are not, since they are meant to be covered. For this reason a resistant shadecloth, such as 'Solartex', could prove effective as a top cover for mattresses.

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[10] J. Ashurst, and F.G. Dimes (eds), *Conservation of Building and Decorative Stone, Vol. II*, Butterworth-Heinemann, London 1990, p. 5.

[11] Bedello Tata and Spada, 1995; R. Albini, A. Costanzi Cobau and C. Zizola, "La conservazione dei mosaici delle Terme dei Cisiarii di Ostia: i risultati", *Atti del III Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico, Bordighera, 1995*, F. Guidobaldi and A.G. Guidobaldi (eds), Bordighera 1996, pp. 491-500.

One of the desired characteristics of a fill and containment material of a covering is that it permits capillary rise of moisture from the mosaic. Ceramic pellets, even if mixed with ceramic powder, are not considered advisable as a mattress fill material since they will not guarantee capillary rise. Research into alternative light-weight porous fill materials for temporary coverings is needed before this protection option can be more widely applied on archaeological sites.

CONCLUSIONS

The *in situ* conservation of mosaics is an eminently achievable aim. It has been shown that the technical means are available to stabilize them *in situ* without lifting as they are excavated, although certain cases may arise that make lifting and relaying a more efficient treatment option. The technical means are also available to protect mosaics *in situ* during and after excavation, either by reburial, sheltering, temporary coverings, or regular maintenance (preventive conservation) in the open air. But even regarding reburial, care should be exercised in the appropriate choice of materials and strategy. More results of research and experiences with reburial need to be shared, and one hopes that the next ICCM conference will address this topic formally. The key to long-term *in situ* mosaic conservation, as with the conservation of all architectural remains of archaeological sites, is, however, planning *prior* to excavation and regular, routine maintenance *after* excavation, i.e., site management. The amount of financial resources available for the treatment and maintenance of excavated remains at a site should determine both the amount of new excavation that is feasible and responsible and the protection option that will need to be carried out afterwards. The various protection options available for mosaics *in situ*, from reburial to regular maintenance, require varying amounts of funding, but they all require some degree of maintenance activity. Lacking a site maintenance budget to carry out a maintenance programme, the future of *in situ* mosaics remains a financial/political problem requiring increased advocacy efforts.

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DISCUSSION

de Guichen: In your paper you were mentioning the labour-intensive and time-consuming aspects of reburial, and I am very happy that you were giving numbers at the end which means that for 500 m^2 it is three dollars per square metre of material which can be reused, and for 500 m^2 it means altogether one man-month in labour. There is no doubt that we need more experiments, we need more exchanges about methods of reburial. Has anyone had experience of reburial?

Corfield: We have been conducting reburial monitoring, as you might know, at the Rose Theatre in London for the last five years now, and we are getting information from that monitoring which gives some indication of what is happening there. But that is only on one very specific site, and I would support your plea for rather more monitoring, rather more research into what happens when we bury. And I would also make a plea for the sort of considered reburial that you have carried out. Rather too often we see the spoils from the archaeological site heaved back into the hole with no reconstitution of the original matrix that came from the ground. So, I think that too is something that needs to be investigated.

Roby: I would like to comment on that, but the primary time-consuming activity at the site, and one of the factors, is the sieving of the soil. I would be curious to know what the backfilling technique used at the Rose Theatre was; maybe people here do not know what system was used there.

Corfield: Briefly, the Rose Theatre is a wet site; it has a clay matrix, and the main purpose of the reburial was to prevent the contraction of the clay matrix. The reburial system was first Terram, then a metre-thick layer of iron-free sand, and incorporated into that a leaky pipe system to maintain a constant water level across the site, to prevent the clay from drying out and also to prevent the deterioration of any organic materials that might still be buried in it.

Edwards: I would like to mention a Roman villa that our archaeological unit reburied in about 1992; an article was submitted to the *Newsletter* so it should have been published. We partially excavated a Roman villa because what we wanted to do, our main process, was to locate the Roman villa but not to excavate it to the floors. The idea of the project was to locate and protect. The villa was partially excavated and only in one extent was it excavated down to a tessellated floor because it was very close to the surface. The point is that we did not fully excavate. The decision had been made before the excavation that we would backfill. First the soil from the site was sieved, it was backfilled across the sensitive areas, and then a geotextile was put on top of that. Overlying the textile we placed more soil, again from the site. And then the whole site was fenced off and protected from ploughing because it is in the middle of an agricultural area. This could be another option which perhaps Gaël might think of, that of location and protection, rather than excavation. Incidental-

ly, we know there are two other villas near to where this particular villa is located, and we know there are mosaics because they were excavated in the '60s. This third villa certainly could have mosaics, but it was located and reburied.

Solar: On the question of reburial, there is an ongoing project of the Getty Conservation Institute; it is on research on reburial in Fort Selden, and that is a long-term project which has already accumulated experience, mainly what is wrong, what are the wrong materials and what not to do. A project that you mentioned that is completed is the reburial of the hominid footprints at Laetoli in Tanzania, where a complicated system of layers of geotextile, geobarrier, and so on, was used. We heard Jacques Neguer, we saw the reburial of the large mosaic at Tel Itztaba; there is also a poster showing Caesarea Maritima, in Israel, with partial reburial. One very important lesson is that you never put the geotextile directly on the surface, and we could see it on your slides as well.

Guex: We have just heard Dr. Solar say that we must not put geotextile directly on the remains. This has also been our experience. Geotextile attaches to any uneven surface, that is, it attaches to a wall. You should put a layer of sand first of all directly on the pavement, and only put the geotextile on top of the sand to avoid it damaging the mosaic. You can always remove sand very easily with a vacuum cleaner.



Fig. 1: Triclinium mosaic, Atrium V, Cosa. Growth of olive tree roots under tessellatum with layer of soil between detached tessellatum and bedding mortar (centre).



Fig. 2: Triclinium. Emergency stabilization by injection grouting of voids around areas of root growth; lime mortar edging of lacunae (right).

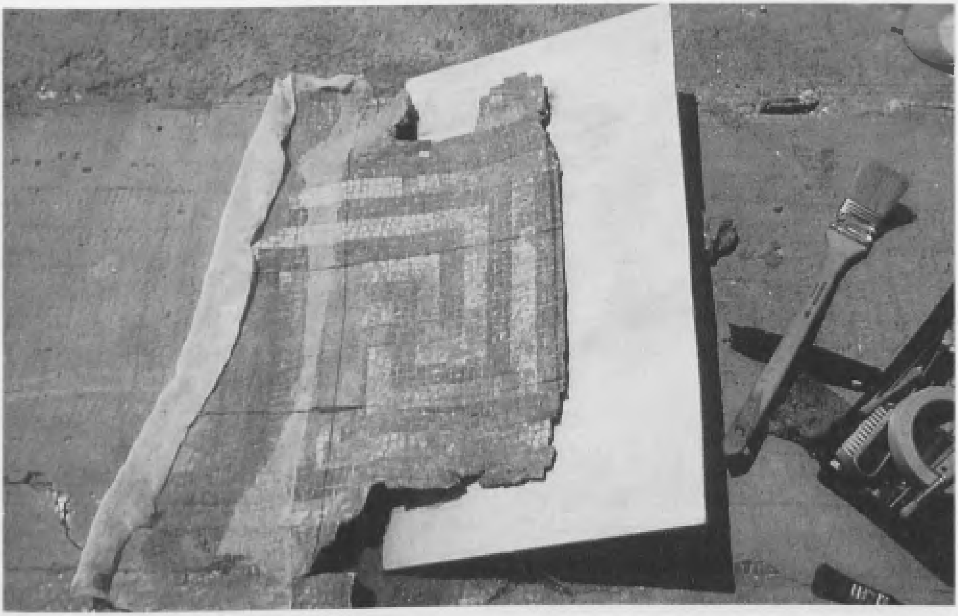


Fig. 3: Triclinium. Surgical removal of olive tree root section using temporary facing; temporary plywood support of tessellatum before resetting on new hydraulic lime and sand bedding, retaining its original raised and deformed surface contour.



Fig. 4: Tablinum mosaic. Partial removal of soil reburial after two years showing penetration of 'Typar' geotextile intervention layer by plant root growth.



Fig. 5: Tablinum. Holes in 'Typar' geotextile (centre) caused by ants after two years of reburial.



Fig. 6: Tablinum. New bulbous root growth at left edge of cut root section which has caused further damage to raised area of tessellatum and cracking of temporary mortar edging repairs.

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Examples of deterioration following preservation works on mosaics *in situ*

INTRODUCTION

Improper preservation of mosaics located in outdoor archaeological sites may not only neutralize what is often complex and costly restoration work, but in a short time may generate significant and irreparable damage to the mosaic materials (tesserae, mortars and stuccoes) and therefore to the entire mosaic. The use of materials, chemical products and inappropriate protection may produce physical stress or create particular microclimates on the surface of the mosaic, thus generating physical and chemical deterioration processes, which may involve portions of or all the mosaic materials. A lack of or poor preservation, which is sometimes associated with improper cleaning and restoration, may produce, for example, incrustations on the tesserae, crumbling mortar with consequent detachment of tesserae, efflorescence on the mosaic surfaces, biological attack, disintergration of mosaic material, detachment of mosaic blocks, etc. The following is a brief overview of some examples of deterioration of mosaics on the island of Cyprus triggered by the lack of or incorrect preservation.

DETERIORATION OF TESSERAE (WHITE AND BLACK) OF THE MOSAICS IN ROOMS 19 AND 57 OF THE VILLA OF THESEUS (PAPHOS, CYPRUS) FOLLOWING THE USE OF POLYETHYLENE COVERS AND EARTH.

Immediately after they were discovered and restored, the mosaic in room no. 19 currently exposed to the environment (Fig. 1) and the one in room no. 57 protected by metal panels located at a height of more than six metres, were covered with polyethylene sheets and then covered with earth. This temporary preservation system caused very noticeable and irreparable damage to the tesserae in just a few years. The two mosaics are made with white and black tesserae. Observations using a mineralogy microscope (Fig. 2) show that the white tesserae are made from micritic limestone with the presence of complete fossils (foraminifera) or fossils which have recrystallized into sparite. In addition, there are traces of quartz and oxide concentrations. The black tesserae, on the other hand, are made from low porosity fine sandstone (contact between the granules is very rare) with sparitic carbonate cement. The granules basically have a silicate composition.

The presence of carbonate granules is undoubtedly secondary. Finally, oxide concentrations and opaque minerals are also present. Both mosaics contain air-setting bedding mortar. In fact, the mortar contains air-setting lime as well as inert materials consisting mainly of carbonate material and small quantities of sand. The deterioration of the white tesserae comprises the presence on the surface of brown incrustations, and pitting and loss of material at the edges. In the case of the black tesserae the surfaces are covered with brown incrustations and there is a major loss of material at the edges.

The brown incrustations which can be observed as stains on the white tesserae should be correlated with the polyethylene covers and earth that inhibited transpiration in the mosaics. The capillary water associated with the condensation and small quantities of rain water, which flowed onto the mosaic through cracks and especially at the edges of the covers, kept the surface of the mosaics wet almost constantly. The prolonged contact between the water and the tesserae led to the disintegration of part of the tesserae. This phenomenon is certainly favoured by the almost exclusively calcareous composition of the tesserae and by a certain degree of aggressiveness of the water. In particular, the water coming from the covering, as a result of extensive stagnation, may place large quantities of organic acids in solution. Therefore, the brown incrustations consist of residues from the tesserae disintegration phenomena (oxides, clay minerals, quartz, etc.), material transported in suspension from the water filtering in through the coverings and finally, in the drier periods, secondary precipitation materials (generally calcite) due to the stagnant water on the surface of the mosaics. The pitting and the greater loss of material from the edges are related to the above-mentioned disintegration phenomena. In particular, the pitting may have been triggered by the use of acids during the 'cleaning' phase that were too strong for the composition of the white tesserae and therefore the subsequent disintegration did nothing but intensify the phenomenon. Instead, the greater loss of material at the edges of the tesserae is due to greater stagnation of the water in these areas. The brown incrustations and the rounding of the black tesserae are caused by the same phenomena that were previously described for the white tesserae. The carbonate cement of these sandstones can enter solution easily, causing the tesserae to come apart and leading to the loss of significant amounts of material. Thus, the brown incrustations consist of silicate granules which did not enter solution and material deposited or precipitated by the water that saturates the tesserae (calcite and in what are decidedly smaller quantities, clay minerals, quartz, oxides and various hydroxides). From this discussion it may be noted that the brown incrustations of the white and black tesserae end up with practically the same composition (calcite, silicate minerals and especially clay minerals, oxides and various hydroxides).

DISINTEGRATION OF THE BEDDING MORTAR, DETRITAL DEPOSITS, STRONG BIOLOGICAL ATTACK (PLANT GROWTH) - BASILICA OF CHRYSOPOLITISSA, 'AYIA KYRIAKI', PAPHOS

The mosaic with geometric patterns (Fig. 3) from the proto-Byzantine age, exposed to atmospheric agents, exhibits different types of deterioration. This mosaic is an exam-

ple of how intrinsic weaknesses of the artefact (composition, form, structure, etc.), along with particularly difficult environmental conditions, may produce what, to say the least, are devastating effects. In fact there is extensive detachment of the tesserae over the entire mosaic, which in some cases is so serious that it is not possible to distinguish the original designs. This is compounded by a massive biological attack. The heavy and widespread deterioration of this mosaic is caused by the composition of the bedding mortar and the presence of dips as well as the total lack of protection. In fact, the air-setting type bedding mortar is not very durable in a humid environment; in other words it tends to become mushy. The presence of dips allows rain water to stagnate and makes it easier to break apart the mortar. In fact, the greatest amount of detachment of the tesserae occurs in these dips. The presence of water for relatively long time periods on parts of the surface of the mosaic also enhances the paedogenesis phenomenon (soil formation) and thus allows more and more complex plants to take root and grow on the mosaic floor. The plants, and more precisely the roots, accentuate the dissolution of the mortar and therefore of the mosaic through mechanical action (root growth that generates pressure on the mortar) and by retaining moisture. On the other hand, the losses of mortar increase the cracking on the surface of the mosaic allowing plants to take root and develop more easily. From these few remarks it can be understood how the two attacks are closely interrelated. In addition, meteoric water not only chemically attacks the mosaic but also transports and deposits detritus (generally mud) as it moves from surrounding areas. Finally, we must add the action of the wind (airborne transport of organic and inorganic material) and temperature difference (thermoelastic process).

DETERIORATION DUE TO SWELLING OF THE REINFORCED CONCRETE SUPPORT, BAPTISTRY OF BASILICA A, AYIOS YEORYIOS OF PEYIA

The mosaic (Fig. 4) with the restoration was placed on a reinforced concrete support, but was not provided with any type of covering. The rain water, penetrating into the mosaic, reached the iron reinforcement, causing it to rust. Thus, the volume of the iron increased and began to exert pressure on the surrounding concrete which has a tendency to disintegrate. The iron swelling effects, most likely still in the initial phases, occur along the surface of the mosaic causing cracks to appear (Fig. 5) that, unfortunately, will almost certainly intensify and become more extensive. This phenomenon, if it continues, might cause mosaic blocks to become detached.

DIFFERENTIATED DETERIORATION OF THE TESSERAE OF THE MOSAIC OF THE ACHILLES' ROOM, VILLA OF THESEUS, PAPHOS

The mosaic (Fig. 6) is currently located in a very narrow closed construction with metal panel, that protects it against atmospheric agents but does not ensure suitable air circulation. Thus, this has created a particular microclimate around the mosaic featuring

alternating periods of heavy humidity, resulting from the capillary water that cannot evaporate efficiently, and very dry periods (summer) with high temperatures. In this particular environment the brown tesserae, unlike the others, tend to become pulverized (Figs 6-7). In various cases, this crumbling effect leads to the total loss of the tesserae with the subsequent deterioration of the mosaic figures. The pulverization of the brown-coloured tesserae is related to their lithological characteristics. In fact, they are made of high porosity fine sandstone with very lean sparitic calcite cement (low degree of cementation), silicate granules and iron oxides (which create the brown colour) in finely distributed concentrations. The disintegration, during the humid periods, of the lean cement, associated with the pressure easily leads to the breakdown of these tesserae. Instead, the other tesserae of the mosaic, which have a different lithology (different composition, greater cohesion and more homogeneity) have greater resistance against the chemical and physical attacks of the particular environment in which the mosaic is located. Subsequently, in an attempt to stop the loss of the brown coloured tesserae, a very questionable red-coloured stucco was used (Fig. 8).

DETERIORATION CAUSED BY THE FORMATION OF EFFLORESCENCE, HOUSE OF DIONYSOS, PANEL WITH THE RAPE OF GANYMEDE, PAPHOS

The mosaic is completely covered by a film of white salts that greatly attenuates the various colours of the mosaic pattern. This efflorescence is caused by phenomena in which material of the bedding and foundation mortar enters solution due to water circulating under the mosaic surface which, through capillary action, reaches the surface precipitating its saline content.

CONCLUSIONS

The few examples analysed in this report highlight just how important it is to combine the activities of finding and restoring a mosaic with a valid preservation project. Poor or deficient preservation may inexorably ruin the mosaic, thus neutralizing all the human and economic efforts made to uncover and restore it. The preservation work, especially when the mosaic will remain outdoors, must be carefully designed and developed starting from the excavation operations. Preservation must first and foremost protect the mosaic against atmospheric agents without creating special microclimates which might be fatal to the work. This preservation work must also be reversible and architecturally integrated into the archaeological site. Obviously, the preservation project should not be separate from the restoration work. In fact, during the restoration phase, the use of foreign matter and detrimental materials for the mosaic (for example, the use of cement mortar supports which accentuate efflorescence) may neutralize any preservation structure. It would be superfluous to emphasize that also during the restoration phase, knowledge of mosaic materials is of fundamental importance to protect the mosaic.

DISCUSSION

de Guichen: [trans.] You have shown the sort of chemical damage that can occur on a site; we have seen biological damage, and now we have seen chemical damage. We should recognize the role of chemists in the team. We have talked about teams - conservators and archaeologists. The chemist also has a role to play, but he has to find his own role. He may have a dual role, either he can think of the past or the future of the work. Today, different deteriorations such as salinity and expansion are well known. The use of harmful substances is well known. I was hoping you would present a few solutions in your paper, because now chemists have to start thinking, not staying in their ivory tower in the laboratory, but thinking in terms of the flooring and how their expertise can contribute to the preservation of the flooring. It is a serious problem in our area with the chemists and scientists who are too often interested in the past of the work, in the composition of substances, the origin of the compounds, and it is very rare for them to contribute solutions that conservators and archaeologists are asking for on a daily basis. The past is the past; what can we offer now?

Anastassiades: [trans.] I would like to mention some personal experience in the mosaics of Cyprus. During my time in the Department of Antiquities and even later, we used to use hydrochloric acid very extensively. The hydrochloric acid was imported to Cyprus in large ceramic, porcelain containers and was used passionately, if I may say so. Then, the mosaic, which had been washed with acid, was covered with polythene which, of course, stopped it from breathing, and the damp remained in the substrates and caused this deterioration. Thus, as the Chairman has said, we must think of how to neutralize this negative impact, to neutralize not only the presence of salt but also oxides which have been added to these tessellated surfaces. Something else which you have said, with regard to cement, that it is the iron that corrodes and causes these cracks; but cement on its own, without the presence of iron, due to its hardness and different movement pattern compared with the limestone mortar materials, causes a fracturing of the tesserae even though there may not be iron in the concrete. We have seen this at Salamis where iron was not present in the concrete, deterioration still occurred.

Menicou: [trans.] Certainly today the technology is available to clean a mosaic or to intervene correctly. It is necessary to have the will to do so, rather than the equipment which is available. To remove the salts from something may be an easy task, and you can remove part of the oxides with water.



Fig. 1: Detail of mosaic in Room 19 of the Villa of Theseus, Paphos, Cyprus.

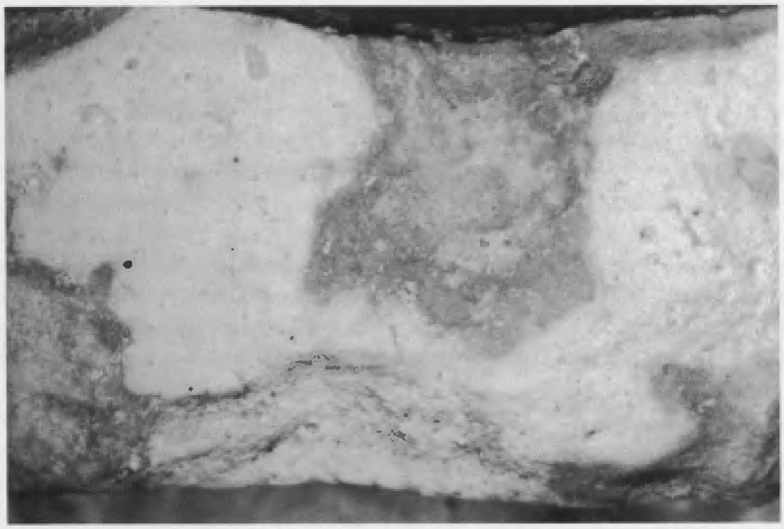


Fig. 2: Section through white tessera from above mosaic.

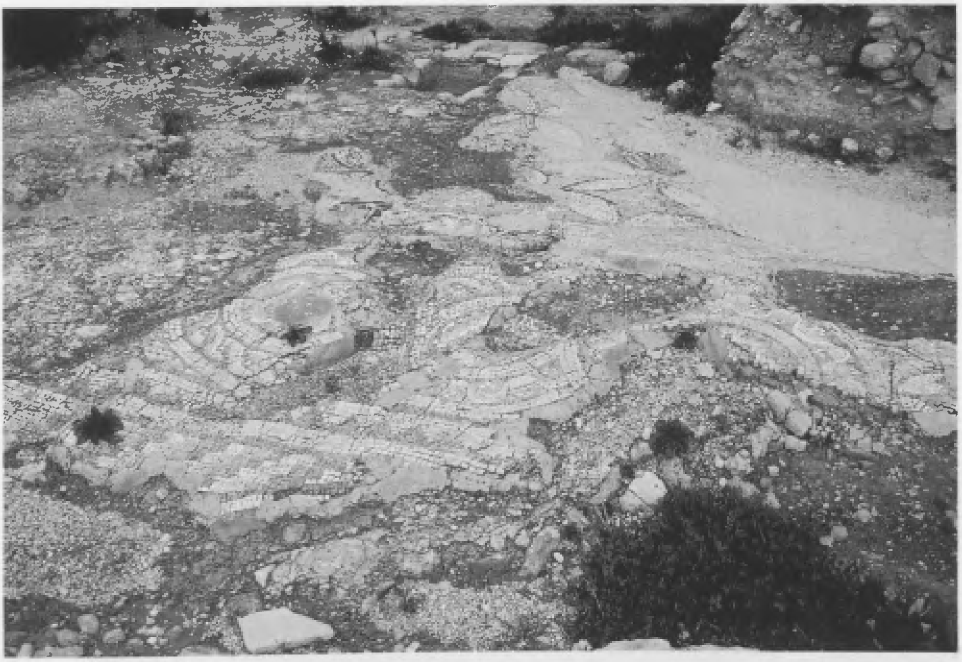


Fig. 3: Geometric mosaic, Basilica of Chrysopolitissa "Ayia Kyriaki", Paphos, Cyprus.



Fig. 4: General view of Baptistry of Basilica A, Ayios Yeoryios of Peyia, Cyprus.



Fig. 5: Detail of geometric mosaic floor of above.







Figs 6, 7 and 8: Details of the mosaic of the Birth of Achilles, Villa of Theseus, Paphos, Cyprus.

Romana Albini and Chiara Zizola

Zippori. *In situ* conservation of a floor mosaic in polychrome stones and glass paste

INTRODUCTION

During the 1991 excavation campaign of the University of South Florida, directed by Prof. J. Strange, in the National Park of Zippori in Israel, archaeologists brought to light the main room of a Roman public building. The floor of the 100 m^2 room consists of a polychrome mosaic dating from the 3rd century AD. The mosaic is exceptional for its artistic quality and for the technique required for its creation. A very elaborate geometric frame encloses 60 figured panels representing animals, fruit, games and musical instruments. These were created with tesserae of stone and vitreous paste in more than 25 different colours, which the artists used to build a sense of volume and to create shadows: browns, reds, pinks and grays, vitreous pastes for the greens and blues. The more detailed panels were made using tesserae measuring from 1 to 5 mm^2 (Fig. 1). Some of them are as small as 1 mm^2 (Fig. 2).

As soon as it was excavated, the mosaic was protected by a temporary covering until the conservation intervention could begin. During the summer of 1995, the CCA (Centro di Conservazione Archeologica) of Rome carried out this intervention *in situ* using conservation techniques that respected both the materials and the technique of the original execution of the mosaic [1]. Lifting methods and synthetic materials were not used. The account of the methods and techniques that were used during the intervention that follows lays special emphasis upon those aspects peculiar to *in situ* conservation in terms of planning and investment of human and economic resources.

THE BIRD AND FISH MOSAIC: DESCRIPTION OF TECHNIQUES AND STATE OF CONSERVATION

The mosaic is in the main room of a public building of the Roman era that is still being excavated. There is as yet no complete description of the building, nor is its function fully understood. The building, visible upon entering Zippori from the main visitors' path, stands very near the *cardo* of the ancient city.

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[1] See also A. Constanzi Cobau and R. Nardi, this volume.

The mosaic underwent many restorations and was much repaired in ancient times in a variety of ways. This demonstrates that the room was much used and confirms the hypothesis that the building itself was an important public structure.

There is a cistern beneath the mosaic that had been used to collect water and the foundation layer of the mosaic floor, made out of hydraulic mortar and calcareous stones, rests on the external side of its vault. Consequently, the second preparatory layer of the mosaic was made of lime, pozzolana and ash, particularly suitable for a mortar that had to be light with hydraulic characteristics. The use of ashes might also have depended upon the need to lengthen the normal hardening time required by the mortar. Examining the preparatory layers where there were lacunae in the mosaic surface, it was possible to study the technique used in creating the mosaic itself, leading to the conclusion that the entire decorated surface was executed *in situ*. This is contrary to the usual method of making *emblemata* in the mosaicist's laboratory, whence they were transported and subsequently placed *in situ*; thus the panels representing animals and musical instruments, made with tesserae measuring just a few square millimetres, were not individual elements, but refined images that were created in place.

The second preparatory layer shows incisions made to divide and square-off spaces for the iconographic composition. These divisions were used to define the work into single work-days. Each day's section was covered with a thin layer of lime mortar and fine stone powder onto which the preparatory drawing was sketched in various colours. Subsequently the tesserae were laid. The incisions and the very shallow (only a very few millimetres thick) bedding layer exclude the possibility that the panels were made elsewhere and then inserted within the geometric decoration that was prepared *in situ*.

The alterations found were those that are usually associated with mosaics in excavation, and mainly affect the preparatory layers, namely the pulverization of the second preparatory layer and resulting hollow areas beneath the tesserae; the detachment, or lifting, between the second preparatory layer and the bedding layer; the pulverization of the bedding mortar and consequent lifting, or detachment of the tesserae; the presence of lacunae; mechanical breakages and settling; and the formation of thick carbonate surface deposits.

THE INTERVENTION

The intervention was carried out following the principles of *in situ* conservation, without using destructive techniques or irreversible operations, such as the lifting of the tesserae. In other words, it was limited to the least possible direct intervention on the surface in order to mend the damage and with the aim of making the decoration legible by using traditional techniques and materials that were compatible with the original structure. Historic traces of the previous life of the building were preserved, such as the signs left by the collapse of the structure and various subsequent restorations. At the same time, measures to prevent future damage and a maintenance programme were planned for the long-term preservation of the mosaic. As a corollary to these aspects, particular impor-

tance was attached to informing visitors who were able to watch all the phases of the work from a terrace-platform built for this purpose along the visitors' path.

The group that carried out the work consisted of six professional conservators from CCA and four local technicians. The intervention was completed in eight weeks. The stages of the intervention were broken down into different stages: planning, documentation, pre-consolidation, consolidation of in-depth detachments, surface cleaning, consolidation of the spaces between the tesserae, treatment of lacunae and final review.

PLANNING AND DOCUMENTATION

Closely connected, these two operations are fundamental to a successful intervention. Following the inspection of the mosaic and the registration and classification of all the alterations noticed, using symbols on the prepared drawings, it was possible to plan the intervention. Documentation before, during and after the actual work is the primary and necessary instrument of conservation. By studying the alterations in the mosaic that have occurred through the years, the traces of the use of the building and the life that went on within it, in conjunction with the techniques that were used throughout, it is possible to move backwards from existing damage to its cause and consequently to establish priorities and to select the most suitable methods and techniques for the intervention. During the planning phase, besides the steps to be taken to strengthen the structure, the techniques to be used for each single operation were defined, the materials were chosen and the time and cost of the operation were established. At the same time, a maintenence programme was scheduled for future conservation and damage prevention.

The planning and the documentation of the work are precious instruments for conservators; constant control of the intervention from the moment it begins means avoiding wasted efforts caused by not having an overall view of the problems. Moreover, the results, positive or negative as they might be, become observable over a long period, allowing the conservator to update and modify his strategies, particularly with regard to preventive measures, as he sees unexpected reactions or errors.

PRE-CONSOLIDATION

Before proceeding with the consolidation of deep detachments, those areas where the tesserae were detached from the bedding layer were temporarily stabilized. These were areas where miniscule tesserae had been used and had lost adherence to the sub-layer, or that were held in place only by earth without mortar. Protective cotton gauze was applied over these areas. A slight cleaning with dry brushes and delicate air spraying was carried out before applying cotton gauze and a solution of 15% Paraloid B72 dissolved in acetone. The tesserae along the edges of the lacunae and those that were at greatest risk of dispersal were fixed with lime-based mortar ($^1/_2$ Lafarge hydraulic lime, $^1/_2$ lime putty, 2 parts sifted stone dust) applied in a fine coat perpendicular to the mosaic surface.

CONSOLIDATION OF THE DEEP-LEVEL DETACHMENTS

This operation was carried out to restore adhesion between layers in detached areas and to compensate in those areas where the mortar in the second preparatory layer was completely disintegrated or missing. By tapping the surface, hollow areas and places where detachment had occurred were discovered. In order to keep a 'control' element during the consolidation, these areas were marked on the surface with masking tape and noted on drawings and 'maps'.

Most of the deteriorated areas were found near lacunae in the mosaic. In these cases it was possible to approach the underlying layers from the inner edges of the lacunae and to remove the disintegrated mortar or earth deposits with a vacuum cleaner and by repeated washing with water using fine flexible metal tubes inserted into the empty areas. In some cases, the cotton gauze alone, applied during the pre-consolidation phase, was sufficient to keep the tesserae in place and to avoid collapse during the work. Where there were no lacunae near the detached areas, small approach holes were created by removing four-six tesserae from the surface. Numbered, classified and their exact location documented, the tesserae were temporarily kept on a clay support until replaced *in situ*. Fine, flexible plastic and metal instruments were introduced through the access holes to remove all the loose deposits. The cleaning phase continued with the removal of deposits with air suction and ended with the rinsing out of the area with water.

The areas prepared in this way were consolidated using a lime-based hydraulic consolidant mixture similar in its composition to the original mortars (Lafarge hydraulic lime, sifted brick dust 1:1 and sufficient water to create a fluid mixture). The consolidant was injected through the holes using hypodermic needles, moving from one hole to another until the entire hollow was saturated. Where it was possible to reach the hollow areas from lacunae edges, the same consolidant mixture was used with less water and it was instead applied with spatulas. The process started from the back of the hollow and moved up towards the edge. Some fragments surrounded by lacunae were raised and then replaced on a new layer of mortar.

At the end of the intervention, once the consolidant had hardened, the cotton gauze that had been applied during the pre-consolidation phase was removed using acetone soaked compresses. The tesserae that had been removed in order to create access holes were replaced using a lime based mortar (Fig. 3).

CLEANING

Both mechanical and chemical cleaning techniques were employed in conjunction with each other. The loose, or semi-loose, deposits were removed by air suction, water and hand-held plastic brushes. After this initial cleaning, a more thorough cleaning took place using nylon brushes and jets of air and water. The thicker deposits (up to 5 mm thick) were reduced using air-powered micro-vibrators.

Further cleaning was carried out with paper pulp compresses soaked in a slightly alkaline solvent (30 gr. ammonia carbonate, 25 gr. EDTA, 10 cc. NeoDesogen per litre of

deionized water) that were applied to the surface for four hours. When the compress, or pack, was removed and the surface rinsed, another pack of paper pulp and distilled water was applied to remove residues of the cleaning solvent (Fig. 4).

CONSOLIDATION BETWEEN THE TESSERAE

This operation was carried out to improve adhesion among the tesserae in areas where the embedding mortar was pulverized. This surface change was widely diffused throughout the mosaic, particularly in areas near the lacunae. The earth or mortar residues between the tesserae were removed mechanically with a specillum and suction and light water spray. Between the tesserae themselves, a liquid, lime-based mortar (Lafarge hydraulic lime, sifted calcareous stone powder, 1:1) was brushed on to fill the empty spaces. Any excess consolidant on the surface was removed using dampened sponges once setting had started, one hour after application (Fig. 5).

TREATMENT OF LACUNAE

In order to create a homogeneous surface, all the lacunae among the tesserae were stuccoed with lime mortar. Closing these spaces was necessary to prevent infiltration by water, earth and débris, since these would give rise to destructive processes. The mortars were chosen with the general shades of the background colour in mind in order to lessen the visual impact created by a broken or interrupted surface, and ideally speaking, reunite the decorative texture. The stucco-work was applied in several thin layers in order to avoid the formation of cracks which might have occurred in an excessively thick layer of mortar. The first layer, from 1-5 cm thick, was a mortar composed of 2 parts of non-sifted stone dust, 0.5 parts Lafarge hydraulic lime and 0.5 parts lime putty. A final layer of mortar was placed on this one. It was composed of 2 parts sifted light-coloured stone dust, 0.5 parts Lafarge hydraulic lime, 0.5 parts lime putty and was applied in layers only a few millimetres thick, leaving a slight depression with respect to the tesselated surface. The mortar was smoothed repeatedly with spatulas to create a smooth-enough surface to resist dust and humidity (Fig. 6).

The small lacunae, where only a few dozen tesserae were missing, were filled using sporadic tesserae. Where there was no doubt about the interpretation of the design, this was recreated with tesserae. Otherwise, even in the case of small lacunae, the spaces were stuccoed with mortar.

MAINTENANCE PROGRAMME

This was a fundamental stage of the intervention. Without a maintenance plan, the intervention executed and the cost sustained would have become useless once the destructive processes connected with the natural deterioration of the materials involved had

set in, particularly since the mosaic was not destined for a specific and continued use. Current damage was corrected and conditions were established for future conservation; specific treatment involving periodic revision of the materials, inspection of the surfaces, prompt substitution of decayed materials, and localized consolidation, will ensure the existence of the mosaic for the future.

Four local technicians worked alongside the conservators for the duration of the intervention. They were trained in consolidation techniques, cleaning and in stuccoing the lacunae and were prepared to handle the most important mechanisms that are involved in the disintegration process. They were made resposible for ordinary maintenance to be carried out monthly.

Ordinary care consisted in dusting the surface with brushes and vacuum cleaners; cleaning surfaces with water-dampened sponges; checking the state of the mortars used during the intervention (for cracks, mechanical damage, etc.) and repairing if needed; and checking for biological growths (plants or algae) and the possible appearance of soluble salts. These simple operations, if carried out regularly, can ensure the future survival of the mosaic without resorting to massive and costly interventions.

INFORMING THE PUBLIC

An essential part of the intervention was to draw up a programme of public information. Visitors were able to watch all phases of the intervention from a terrace built for this purpose along the visitors' path. Guided tours and illustrated information panels transformed this conservation intervention into a cultural event, making the public aware of the questions of safeguarding the mosaic and at the same time making the work available for close observation (Fig. 7).

CONCLUSIONS

We feel that the archaeological site of Zippori represents the changes that are slowly coming about in the actual choice of intervention among those who are directly responsible for the conservation and safeguarding of cultural properties.

In just a few years, many monuments of great historical and artistic value have been discovered in Zippori. From as recently as 1989 to the present, an aqueduct and five buildings have come to light; the latter made even more precious by the presence of about 20 floor mosaics of extremely high technical and stylistic quality. This is an archaeological site which annually welcomes a number of archaeological campaigns that continue to discover a great quantity of artifacts. All these historical and artistic properties should and will be conserved for the future, protected and presented to the visiting public. Available economic resources will be distributed so as to obtain the greatest possible level of safeguarding and use of all the monuments. Starting from the 'restoration' of simple mosaics (and by restoration we mean lifting the mosaic, resetting the tesselated work on cement, taking into consideration only the aesthetic aspects of the object), there has been a ten-

dency towards *in situ* conservation of entire monuments in overall, comprehensive long-term preservation programmes. The characteristics of this kind of intervention can be summed up as follows:

- *in situ* conservation with minimal intervention, the purpose of which is to restore the conditions necessary for future conservation and to maintain the visible traces of the monuments' existence in time;
- the use of materials and techniques that are compatible with the original structures, or at least materials whose compositions are exactly like the originals, easily obtainable and not costly;
- organization of maintenance programmes to be respected through the years and entrusted to local technicians trained during the intervention;
- plan of the measures to be taken in order to prevent future damage;
- inviting public visitors to the site and providing them with relevant information.

Acting this way is advantageous from many points of view. From the economic viewpoint, the investment is limited regarding both the techniques and the materials used, as well as the employment of local technicians and workers for maintenance. This prevention programme is even more convenient considering how high the risks of damage can be, with the consequent need for costly future restorations. But the most significant aspect, we feel, lies in the ability to preserve the monuments as they have been retrieved from the ground, and to pass on, as far as possible, the historic information we receive from them, to limit disturbance to the minimum, to enhance the traces of the monument's life in its previous existence, to awaken public opinion to the conservation of our historic memory by direct involvement and through accurate information. These, we believe, embody the greatest of all possible investments for the future.

DISCUSSION

Weidmann: [trans.] In this specific intervention, what steps were taken to solve general problems such as drainage and the future shelter for the mosaic? Will it remain in the open?

Albini: There will be a permanent roof to protect the mosaic from running water, wind and rain. It cannot be transparent to avoid direct sunlight falling on the surface of the mosaic. Another preventive measure will be the construction of barriers to prevent the public walking on the mosaic.

de Guichen: [trans.] Has this been done yet?

Albini: Not yet, but we hope that they will do it.

Hadjichristophi: Perhaps I missed your comment on this, but I did not understand why in some places you left the lacunae and you just consolidated the edges of the mosaic, and the other mosaic was filled with mortar.

Albini: We left just one lacuna without stucco because we found some bones there; we thought it might have been a fireplace, and we left it for study by the archaeologists.

Chiotis: [trans.] I would like to ask about the large area of mortar which was placed in the damaged parts of the mosaic; we saw one of the two ladies using a small spatula to smooth it. What kind of mortar did they use, and what protection measures did they take so that it would not crack?

Albini: The mortar that we used was composed of slaked lime and stone dust. We applied it to the lacuna in two layers, the composition of which differed. The first was composed of one part of slaked lime and three parts of stone dust, not sieved; the second consisted of one part of slaked lime and two parts of sieved stone dust. In answer to your second question, after the first layer had set and was dry, we applied the second layer, wetting the area, and that is all. We smoothed the surface very well to prevent cracks.

Chiotis: That was not my question. I know about mortar. Mortar has problems in large surfaces when it is laid in a certain season of the year; and it should be laid either early in the morning or protection measures should be taken so that it does not crack — not immediately, but after a certain amount of time. I know the various layers; I am not asking about that. I just want to ask you what time of the day was it and what season of the year, winter, autumn or spring? And what protection measures did you take while you were laying the mortar so that it would not be destroyed in the future?

Albini: We applied the mortar with a lot of water because we work during September, so it was quite dry. And we sometimes cover the stucco with plastic to avoid the fastdrying evaporation of the water, to permit the slaked lime to carbonate slowly, to prevent cracks.

Kamaraki: I have some questions about grouting in floors; I have often thought about this. I have seen that you use a material which contains a great deal of water — it is very fluid, very liquid. Once you have filled the lacuna, do you control it, do you monitor it after a certain amount of time? And to what extent is this new material cohesive with the old when it touches the old material? And the second question, the lacunae that you fill with these other materials that you use, which is completely white, how do you deal with these lacunae aesthetically?

Albini/Zizola: After the injection of the consolidant, after the setting of the consolidant, we monitor by tapping the surface to see if the consolidant is sufficient. If it is not, we can go back and fill it again. We fill the lacunae with mortar using local stone dust. The colour does not disturb the aesthetic quality of the mosaic.

de Guichen: I imagine that every conservator here in the room knows that with the same product and with the same recipe, you can obtain different results. It is a little like cooking. Sometimes it works and sometimes it does not work. Now I would like to change the orientation just a little. I think it would be interesting to know how the public react and how it will react. And I will put the question: did the fact that the public were present oblige you to work in a different way? We have spoken of a change in mentality; what does this change in mentality mean? How did the presence of the public make you change? Or perhaps it did not result in any change.

Albini/Zizola: It makes us very patient with the public because it is sometimes difficult to work and at the same time to answer their questions. But it is a good school for us.

de Guichen: Did you organize your time in order to answer the public or did you just answer when somebody shouted loud enough with a question?

Albini/Zizola: No. We gave out some pamphlets that described our intervention, and we informed the guides of the park about our intervention.

de Guichen: When there was a large group did you go to answer their questions?

Albini/Zizola: Yes. One person would provide an explanation of the work.

de Guichen: One further question. In the organization of your work on the site itself, were you obliged to work in a different way?

Albini/Zizola: Yes. We had to build a terrace to permit the public to come very close to us so that they could see what we were doing.

de Guichen: I was surprised at your slides that the site was very, very clean. Were you obliged to keep it clean? Generally, when you see a conservation workshop, there are lots of boxes and other things; I do not mean to say it is messy, but there is a certain order which is specifically a conservator's order. Obviously some of you are laughing, so you understand. On the floor things do not look like this; does that mean that you cleaned the site every day or because you were taking photos for this conference?

Albini/Zizola: No, no.

Margalit: First of all, it was a great pleasure to work with the group because what you have seen here, I saw day by day. There was full cooperation with us and with the Antiquities Authority, so it was not only theory, it was work in the field. The roof that you just mentioned has been constructed; it is a temporary roof because we still do not have the money for the permanent roof, but it has been done and also the drainage system. We have done everything, and we will continue with the maintenance.



Fig. 1: General view of the floor after the intervention.

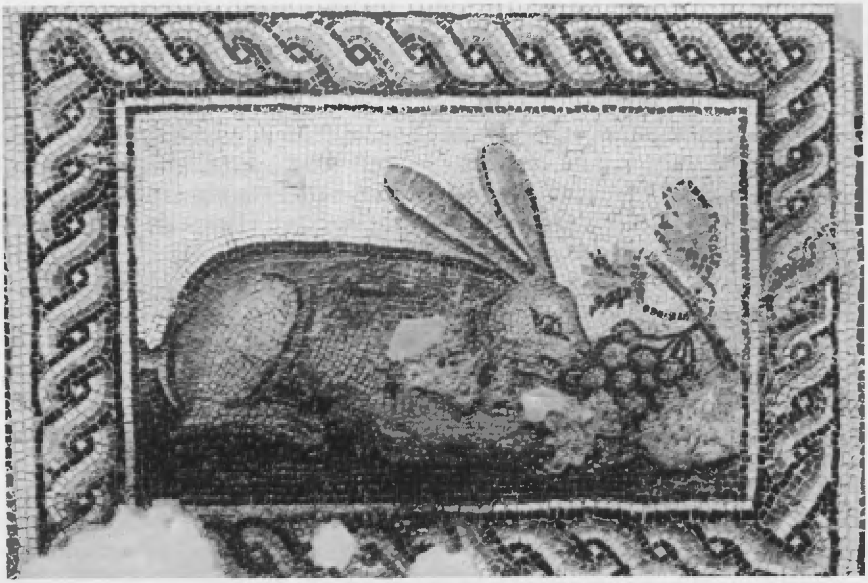


Fig. 2: Detail.



Fig. 3: Consolidation of the deep-level detachments. This operation was carried out to restore adhesion between layers in detached areas and to compensate in those areas where the mortar in the second preparatory layer was completely disintegrated or missing. The areas prepared this way were consolidated using a hydraulic consolidant mixture based on lime, whose components were similar to the original mortars (Lafarge hydraulic lime, sifted brick dust 1:1, and sufficient water to create a fluid mixture). The consolidant was injected through the holes using hypodermic needles.



Fig. 4: Further cleaning was carried out by using paper pulp compresses soaked in a slightly alkaline solvent and followed by packs of paper pulp and distilled water.



Fig. 5: Consolidation between the tesserae. This operation was carried out by applying a liquid, lime-based mortar.



Fig. 6: Treatment of lacunae. In order to create a homogeneous surface, all the lacunae among the tesserae were stuccoed with lime.

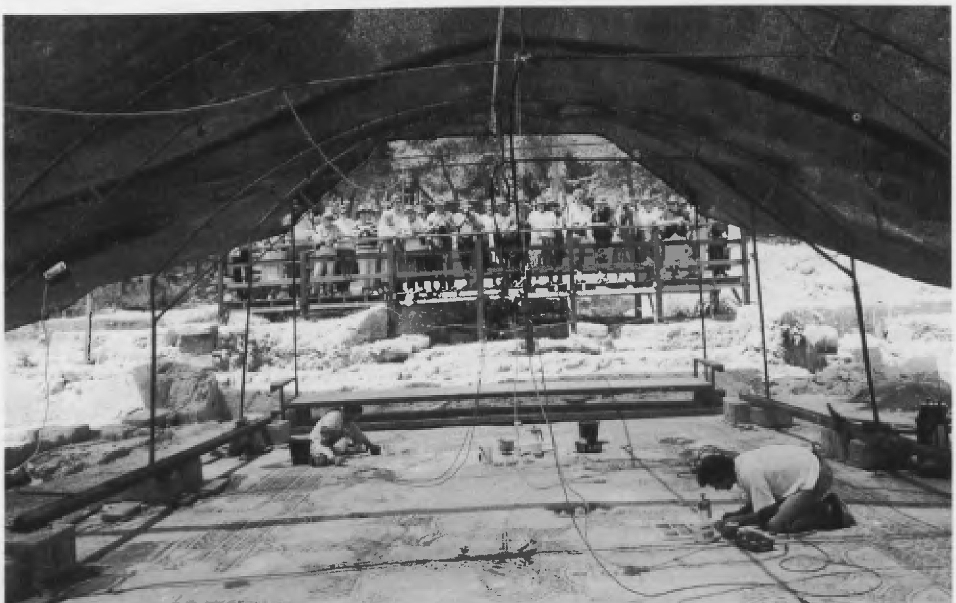


Fig. 7: Informing the public. An essential part of the intervention was to draw up a programme to inform the public. Visitors were able to watch all the phases of the intervention from a terrace built for this purpose along the visitors' path. Guided tours and illustrated information panels transformed this conservation intervention into a cultural event, making the public aware of the questions of safeguarding the mosaic and at the same time making the work available for close observation.

Antonella Altieri, Domenico Poggi and Sandra Ricci

Mosaic pavements from the *Thermae* of Caracalla (Rome): biodeterioration and methods of control

INTRODUCTION

In the Mediterranean basin outdoor mosaic pavements may be susceptible to biological decay by both micro- and vascular flora. Studies carried out on the characterization of the biodeteriogens in archaeological areas have mainly taken into consideration the lichen and phanerogamic flora [1]; only recently have studies also been carried out on the bryophytes, including the mosses and the liverworts [2].

The establishment of the bryophytes is a serious problem for conservation since the growth of these organisms can, with time, cause structural damage to the lithic surfaces. Some studies carried out to identify the role of the bryophytes in biodeterioration have demonstrated that the damage produced by the growth of these organisms is not only limited to the well known and predictable mechanical damage due to the growth of the anchoring organ (rhizoid) but also to a depletion of calcium ions from the substrate mediated by ionic contact-exchange mechanisms [3].

This report analyses the moss flora covering the surface of some mosaic floors of the Thermae of Caracalla in Rome, in order to define the relationships both with the major

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[1] G. Caneva, G. De Marco, A. Dinelli and M. Vinci, "The wall vegetation of the Roman archaeological areas", *Science and Technology for Cultural Heritage* 1, 1992, pp. 217-226; *idem*, "Le classi *Parietarietea diffusae* (Rivas Martinez 1964) Oberd. 1977 *e Adiantetea* Br.-Bl. 1947 nelle aree archeologiche romane", *Fitosociologia* 29, 1995, pp. 165-179.

[2] J.A. Gil and C. Saiz-Jimenez, "Biodeterioration of Roman mosaics by bryophytes" ("Biodétérioration des mosaïques romains par des bryophytes"), *VII Intern. Congr. on Deterioration and Conservation of Stone, Lisbon 15-18 June*, Lisbon 1992, pp. 511-519; G. Saiz-Jimenez, J. Garcia Rowe, and J.M. Rodriguez Hidalgo, "Biodeterioration of polychrome Roman mosaics", *Inter. Biodeterioration* 28, 1991, pp. 65-79; A. Altieri and S. Ricci, "Il ruolo delle briofite nel biodeterioramento dei materiali lapidei", in V. Fassina, H. Ott and F. Zezza (eds), *III International Symposium on the Conservation of Monuments in the Mediterranean Basin (Venice, 22-25 June 1994)*, Venice 1994, pp. 329-333.

[3] J.W. Bates, "The role of exchangeable calcium in saxicolous calciole and calcifuge mosses", *New Phytol.* 90, 1982, pp. 239-252; Altieri and Ricci 1994, *op. cit.;* S. Ricci, A. Altieri and M. Coladonato, "Meccanismi biochimico-fisiologici causati dalle briofite nel processo di alterazione dei manufatti lapidei", *Giorn. Bot. Ital.* 129/2, 1995, p. 72.

environmental conditions which favour biological growth and with the conservative state of the mosaic floors themselves. This kind of analysis may be useful for the evaluation of possible restoration strategies in order to modify the microclimatic conditions and thus gain an indirect control of the biological growth. However, in many cases, only a periodic application of biocide on outdoor mosaic floors is sufficient to allow the control of tallophyte and moss growth.

It is common knowledge that the major characteristics of biocides suitable for application to objects of archaeological and historical interest have a high efficiency against biodeteriogens, low toxicity (for the operator and low risks of environmental pollution) and no interference with stone materials. The use of these chemicals requires a selection of the most effective biocide at the site, since many factors may influence its efficiency. For this purpose, three biocides were tested to verify their efficacy against the growth of mosses on mosaic floors in this archaeological area.

MATERIALS AND METHODS

The study was carried out in the archaeological complex of the Thermae of Caracalla, an example of bath architecture of the Imperial age (212 AD). This site (400 x 328 m^2) is located in the city of Rome in an open green area, including the Roman Forum, the Palatine and the archaeological park of Appia Antica.

In this site, a considerable number of outdoor mosaic floors are located in their original position, and they have had different conservation histories from the time of their excavation, which was mainly carried out in the 18th and 19th centuries (Fig. 1).

A study was carried out on the moss flora present on some of the floors which are of two main types: 1) floors open to the sky adjacent to high walls (6-7 m); 2) floors open to the sky located in the central area of the Thermae and distant from structural walls. This study was part of a larger research project to characterize the bryophyte flora present in some of the archaeological areas of Rome [4]. The nomenclature of the species follows that of Cortini Pedrotti [5].

The lithotypes making up the floors were identified by macroscopic examination as white marble, '*Giallo Antico*' or 'Numidian marble', '*Porfido Verde Antico*', '*Porfido Rosso Antico*' and leucitic basalt [6]. The establishment of the presence on each lithotype of algal

[4] M. Aleffi, A. Altieri, C. Cortini Pedrotti and S. Ricci, "Flora briologica di siti archeologici della città di Roma e considerazioni ecologiche sul ruolo delle briofite nel deterioramento dei manufatti lapidei", *Informatore Botanico Italiano* 29/2-3, 1997, pp. 239-257.

[5] C. Cortini-Pedrotti, "Check-list of the mosses of Italy", *Fl. Medit.* 2, 1992, pp. 119-221.

[6] Words in italics indicate the traditional or historical names of materials and do not correspond to their petrographic definition. On the other hand the terms 'white marble' and leucitic basalt refer to the geological-petrographic terminology. The '*Giallo Antico*' or 'Numidian marble' is a micro-crystalline calcareous rock constituted mainly of Ca_2CO_3 with scatterings of limonite; the '*Porfido Rosso Antico*' is an andesite made mainly of silica, rich in Fe and Mn; the '*Porfido Verde Antico*' is a rock made of aluminated silica of calcium and sodium and Mg silicates; the leucitic basalt is an effusive igneous rock

patina or lichen thalli and the documentation of their relationship with the structure of the material were carried out by the preparation of cross sections and thin stratigraphic sections. Some fragments of adhesive mortar were also examined under the stereo and light microscope following the preparation of sections for their characterization.

In addition the level of moss covering on different stone materials making up a polychrome mosaic floor from the western *Palaestra* was quantified. The study was carried out on surfaces having high and homogeneous levels of colonization, for the evaluation of the effective area occupied by the mosses. For each lithotype two sampling areas were examined each having similar characteristics (exposition, inclination, distance from the walls, state of conservation).

BIOCIDE TESTS

A polychrome mosaic floor in the western *Palaestra* of the Thermae of Caracalla was selected to test the effectiveness of three biocides.

The following easily available biocides were selected from those commonly used in restoration works: Preventol R80 (Bayer) (alkyl dimethyl benzyl ammonium chloride) and Metatin N58-10/101 (Acima Chemicals) (tributyltin naphtenate + quaternary ammonium salt) are microbiocides with a wide spectrum of action against bacteria, fungi and algae [7]; Roundup (Monsanto) *(N*-(phosphonomethyl) glycine) is a herbicide commonly used in archaeological areas [8].

Each of the three biocides, as well as distilled water used as a solvent, were separately tested on homogeneous surfaces of each of the four lithotypes. All biocides were applied over the selected lithoid surface as a 3% solution in distilled water by vaporizer (sprayer). The biocide solution was sprayed twice, with a lapse of one week, in April 1995.

From the date of the second treatment, periodic macroscopic observations were carried out for one year.

RESULTS AND DISCUSSION

As regards the state of conservation of the mosaic floors, two main categories are recognized: 1) mosaics in a good state of conservation showing only a slight presence of

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made of SiO_2 and Al_2O_3. See L. Lazzarini, *Corso di Petrografia Applicata - Appunti delle lezioni*, Università degli Studi di Roma "La Sapienza". Dip. Scienze delle Terra, 1989; *idem*, Recensioni: *Marmi Antichi a cura di G. Borghini*, De Luca (ed.), 1989, *Bollettino di Archeologia*, 1990, Istituto Poligrafico e Zecca dello Stato; A. Mottana, R. Crespi and G. Liborio, *Minerali e Rocce*, Ed. Mondadori, 1977; G.C. Negretti and B. Di Sabatino, *Corso di Petrografia*, Ed. CISU, Rome 1983.

[7] C. Jaton, G. Orial and A. Brunet, "Action des végétaux sur les matériaux pierreux", *V Int. Congr. Deterioration and Conservation of Stone, Lausanne* II, 1985, pp. 577-586; Caneva, De Marco, Dinelli and Vinci 1995, *op. cit.*

[8] G. Caneva and G. De Marco, "Il controllo della vegetazione in aree archeologiche e monumentali", *Atti del Congr. "Scienza e Beni Culturali" Bressanone 24-27 giugno 1986*, 1986, pp. 553-570.

micro-organisms such as cyanobacteria, algae and lichens, indicating an initial stage of colonization; 2) mosaics with disintegrated mortars and many hollows and lacunae, due to the loss of the stony tesserae, showing a large growth of micro-organisms, mosses and plants, indicating more evolved stages of colonization.

The mosaics in a good state of conservation were located in environmental conditions which were characterized by a scarcity of water or which had recently been restored. Most of the excavated mosaics had been restored in 1958 and in 1969, some of which had been completely removed and then remounted *in situ*[9]; many others are currently covered with sand for conservation purposes.

The mosaic floors that show a diffuse growth of moss are situated not only in humid and shaded areas but also in areas which are more exposed and thus subject to atmospheric agents. In the first case the floors also show an evident light green algal patina, whereas in the sunnier areas the presence of the mosses is often associated with a growth, sometimes extended, of lichen thalli and of grey-black algal patinas.

The bryological flora found in the areas examined consisted of 17 moss taxa. The study of the ecological needs of the identified taxa as far as the temperature and humidity are concerned, indicate that the xerophilous taxa (88%) were prevalent in comparison to the mesophilous taxa (12%).

Table 1. Moss flora on mosaic floors located in different areas of the thermae. (**a**: central area, western *Palaestra*; **a1**: perimetric area, western *Palaestra*; **b**: western *Apodyterium*)

Species / relevé	**a**	**a1**	**b**
Didymodon luridus	+	+	+
Bryum bicolor		+	+
Didymodon vinealis		+	+
Tortula muralis	+	+	
Barbula convoluta	+	+	
Bryum caespiticium	+	+	
Pseudocrossidium hornschuchianum		+	+
Cheilothela chloropus	+		
Bryum radiculosum	+		
Didymodon fallax		+	
Bryum argenteum		+	
Scorpiurum circinatum		+	
Tortella nitida			+
Fissidens viridulus		+	
Rhynchostegiella tenella var. litorea			+
Eurhynchium schleicheri		+	
Tortella inflexa		+	

[9] A. Cassio, "Détachement des mosaïques - methode du puzzle", *Mosaic* 2 (ed. G. de Guichen), 1981; *idem*, "Per una nuova tecnica di restauro musivo", *Metodologia e prassi della conservazione musiva*, 1983, pp. 71-86.

In Table 1 the floral samples relative to three different floor areas are compared: (a) the central area of the western *Palaestra* (Fig. 2); (a1) the perimetric area of the western *Palaestra* (Fig. 3); (b) floors of the western *Apodyterium*. The areas (a1) and (b) conform to the first type of floor described above, that is those open to the sky adjacent to structural walls; the area (a) represents the second type of floor, made up of floors open to the sky but distant from perimetric walls.

Taking into consideration the ecological requirements of the species, it is interesting to note that the taxa present in the two areas (a) and (a1) of the *Palaestra* are all thermo-xerophilous with the exception of *Bryum bicolor*, a species which is moderately hygrophilous; in area (b) 50% of the species are sciaphilous and mesophilous. The conditions which provide more shade and more availability of water on the different floors seem to play an important role in the biological colonization, quantitatively and qualitatively selecting the species.

Although the colonization by mosses above all concerns the mortar of the mosaics, it was decided to examine the role played by the type of stone in determining the presence of different species. To this end floral samples from area (a) and area (b) from the two polychrome floors of the *Palaestra* were compared, discriminating between the presence of the species on the four different lithotypes (Table 2).

Table 2. Moss species on the different lithotypes of the two polychrome mosaic floors in the western *Palaestra*.
(**wm**: white marble; **ra**: '*Porfido Rosso Antico*'; **ga**: '*Giallo Antico*'; **va**: '*Porfido Verde Antico*')

Species/lithotypes	**wm** **ga**	**ra** **va**	**ga**	**va**	**wm**	**ra**
Didymodon luridus	+ +	+ +	+	+	+	+
Tortula muralis	+	+		+	+	+
Didymodon vinealis	+	+			+	+
Bryum bicolor	+				+	+
Pseudocrossidium hornschuchianum	+	+		+	+	+
Cheilothela chloropus		+				
Didymodon fallax				+		
Scorpiurum circinatum					+	
Barbula convoluta				+	+	
Bryum argenteum					+	
Bryum caespiticium				+		
Bryum radiculosum	+					

The species *Didymodon luridus* and *D. vinealis* are present on all four lithotypes even if *D. vinealis* is present only in area (a1). In this area, which is more shaded and faces north-east, the white marble is host to the greatest number of species (8/10) and this could

be interpreted as being a consequence of its mineralogical and petrological characteristics in conditions where more water is available. This kind of rock is also the one which is most degraded, since the material shows fissures and superficial degradation. Examination of the thin sections when wet allowed the verification of how the white marble shows phenomena of cracks between its crystals, which in some cases are made more evident by the penetration of the microflora (cyanobacteria, algae and lichens) up to depth of 1.5 mm into the microfissures. The biological structures which start from the inter-granular spaces push themselves in some cases even into the inside of the calcite crystals, using as entry points the lines of cracks and gemination; this development is possible because the calcite is translucent. The sampled material shows a porosity of the inter-crystalline kind, which increases towards the external surface favouring colonization by different species.

It would seem to be impossible to show such a selective effect for the other lithotypes which make up the other examined mosaic floors, although they possess different petrological characteristics from the white marble. Nevertheless, it is interesting to note that the bryophyte cover seems on first inspection to be present in varying degrees on the different lithotypes. In particular the study carried out to quantify the effective surface occupied by the mosses on the lithotypes of the floor in area (a1) allowed the verification that the values for the area covered, expressed as percentages of colonized surface, are greater in the areas on '*Porfido Rosso Antico*' (43%) and '*Porfido Verde Antico*' (39%) compared to those for the 'white marble' (22%) and for the '*Giallo Antico*' (15%).

The different levels of moss covering might be due mainly to the different conservation states of the mortars, since no significant difference in the tesserae size and in the densities of stone tesserae were observed, although the features of each lithotype (colour, porosity, specific heat) may play an important role in influencing the microclimatic condition of the mosaic surface.

On the basis of chemical-mineralogical characteristics the examined lithotypes can be divided into two groups: *carbonaceous* rock made from calcite (white marble and '*Giallo Antico*') and *siliceous* rock made from silicates and silicon-aluminates of calcium, sodium, potassium, magnesium and iron, with which iron oxides are also associated. From the point of view of texture the two groups are different from each other, although each group is quite homogeneous within itself. In fact the carbonaceous rocks are characterized by the association of calcite crystals which are more or less coarse forming a mosaic structure. They show low total porosity (total volume of the void) which is essentially due to inter-granular types of pores, that is fine fissures between one crystal and another. The rocks in the second group show porphyritic structures which are determined by a mass of fine crystals that surround numerous large crystals of silicates (phenocrystals). The porosity is mainly due to tiny cavities present in the body mass and secondarily due to fissures present between the crystals and this mass.

The difference in porosity between the two groups of rock basically resides in the morphology and in the porosimetric distribution more than the total porosity which is from 0.5 to 1.5%.

The analysis of the mortar showed a composition and a stratification which was relatively homogeneous. The samples examined are made up of a 'preparation layer' made

only of lime and pozzolana which follows the real 'layer of adhesion' made only of carbonated lime. Some portions of the samples had a structure which was slightly different, but still classifiable as pozzolanal mortar. It is probable that this is due to repairs during recent restoration work.

EFFICIENCY OF BIOCIDE TESTS

In Fig. 4 the polychrome mosaic floor of the west *Palaestra* is schematized and each of the three biocides applied on each of the four lithotypes is indicated.

The efficiency of the different biocides was evaluated both by sight by surveying the necrotic status of moss cushions and recorded by photographic documentation for comparison of moss growth with time.

With the environmental conditions of this site, the main differences of efficiency among the biocides are the following: after one month, all the areas treated with the three different biocides showed similar action, with visible effects such as necrosis of cushion mosses; after 10 months, on the surfaces treated with Metatin N-58-10/101 and Roundup, recovery of the same moss cushion was observed, while those treated with Preventol R80 did not show any recovery. However it should be noted that after the biocidal treatments no mechanical removal of the necrosis biomass was carried out as is usual in a restoration procedure.

In the short term, the efficiency of the three biocides was similar for the different species. No macroscopic modifications were observed on the surface of the four lithotypes as a consequence of the biocide treatments.

CONCLUSIONS

The floristic study and the analysis of the ecological characteristics of the individual taxa of the mosses have demonstrated that conditions which provide more shade and more available water on the floors in the different environments play an overriding role in the quantitative and qualitative selection of species in comparison to the role played by the stone substrate.

The characteristics of the stone material seem to have a certain influence on the level of moss covering. The substrates which are of siliceous rock have much more consequence for the moss growth than the carbonaceous rock substrates. This evidence may correlate well with the different chemical-mineralogical compositions and with the consequently different physical behaviour of the materials. In fact the rock with the silica matrix can offer a substrate which is richer in nutrients (K, Na, Mg, etc.) that are leached into the rainwater, and are fundamental for the growth of the organisms. Furthermore, the discrete presence of melanocratic components in the siliceous rock, composed of iron and magnesium, brings about extreme temperature and thermic fluctuations which are more accentuated than those found in carbonaceous rock; this also contributes to the dis-

integration of the adhesive mortars [10], with the formation of protosoil and soil, favouring the development of bryophytes. A higher level of moss covering brings about, with time, a more developed protosoil that favours the entry of grasses (Fig. 5).

The interventions aimed at the control of the biological growth are necessary to avoid the settlement of new and more evolved biocoenoses that may result in greater damage to the mosaic floor.

As far as the investigation of biocide efficiency is concerned, the microbiocide Preventol R80 was the most effective in controlling the growth of the mosses over time, within the environmental and experimental conditions of this study. Its effectiveness against the moss flora lasted for 10 months following its application. However, if it is decided to carry out a biological growth control using the periodic application of biocides, since no modification of the environmental factors is possible, it will be necessary to carry out further investigations, including some in laboratory conditions, to verify the possible interference of the biocides with lithotypes.

ACKNOWLEDGEMENTS

We are very grateful to Dr. I. Iacopi, Dr. M. Piranomonte and C. Conti of the Soprintendenza Archeologica di Roma, for their kind collaboration. This work has been supported by an I.C.R. and C.N.R. grant for "Biologia applicata alla conservazione".

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[10] F. Calvino, *Lezioni di Litologia Applicata*, Ed. CEDAM, Padua 1967.

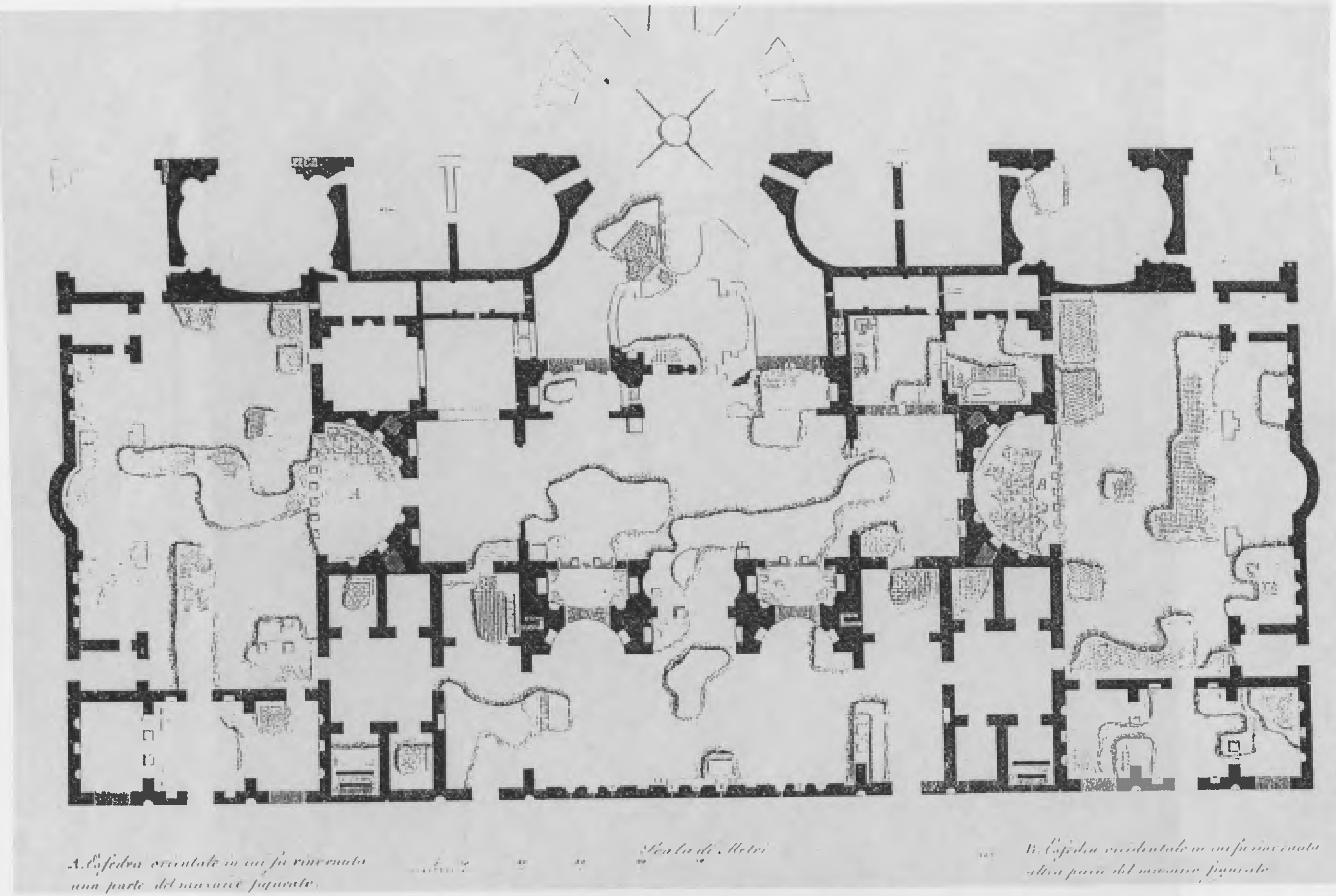


Fig. 1: Plan of the Thermae with some excavated mosaic pavements (after A. Blouet, *Restaurations des Thermes d'A. Caracalla à Rome*, Paris (1828)).

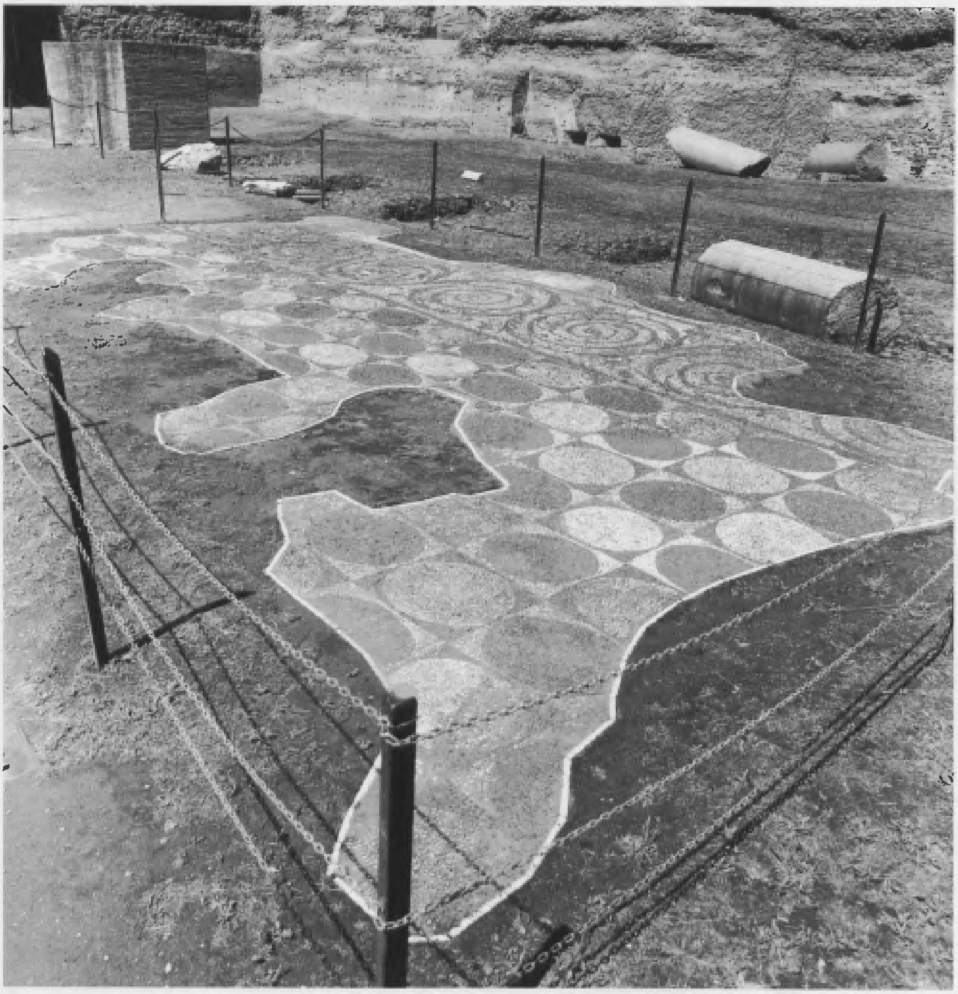


Fig. 2: Polychrome mosaic floor in the central area of the western *Palaestra.*



Fig. 3: Polychrome mosaic floor in a perimetric area of the western *Palaestra*.

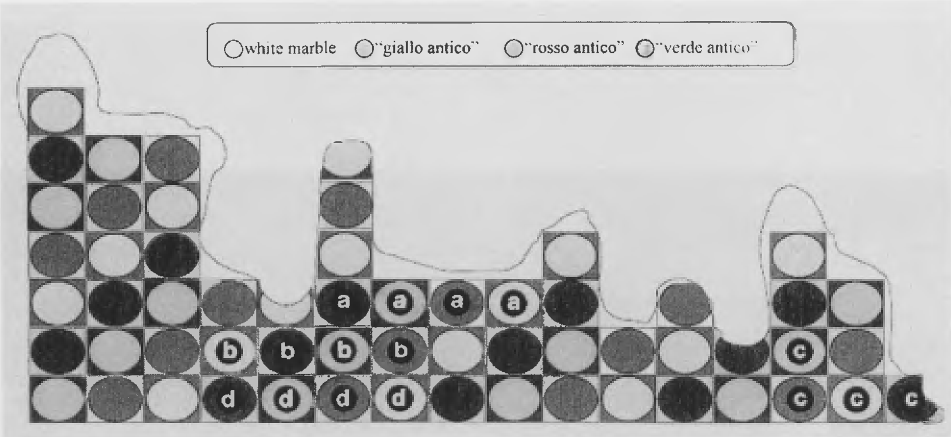


Fig. 4: Polychrome mosaic floor of the west *Palaestra*. The letters indicate each of the three biocides tested on each of the four lithotypes (a: Preventol R80; b: Metatin N58-10/101; c: Roundup; d: distilled water used as solvent).

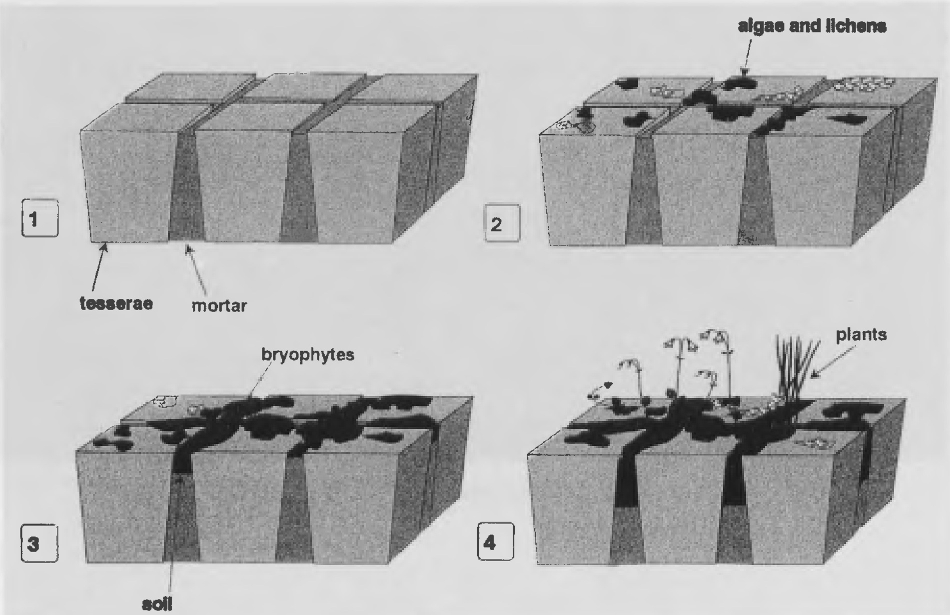


Fig. 5: Scheme of the relationships between mortar disaggregation and biological colonization.

SESSION 5

SHELTER PROTECTION FOR *IN SITU* MOSAICS

Giora Solar

Protective shelters

This paper was originally a general view of the state of shelter designs accompanied by a large number of slides. This review though can be summarized in a very few, full sentences.

The kind of shelters on sites are almost as varied as the number of designers involved in designing them. They vary from the most simple, temporary shelters, which provide protection from sun and rain during field campaigns, to the most complicated, permanent buildings, providing diverse protection, presentation and management solution opportunities. The shape and the materials are usually the result of the designer's preference and choice. Being built on open, archeological sites, shelters almost without exception are intrusive visually. Quite often they are also problematic archaeologically since they need foundations, which would be in the archeological context.

A more detailed review of the kinds of shelters that do exist seems to us as being of very limited value, if not accompanied by a critical analysis of what leads to the designs that we know, how do the existing shelters perform, and what should be the guidelines for designing protective shelters for mosaics *in situ.*

This evaluation and analysis seem critical not just because mosaics keep being uncovered and many shelters exist already, but also because at the times these lines are being written, shelters are being considered, designed and constructed.

The knowledge basis for designing shelters is extremely poor and relies on assumptions and visual observations. The main assumption is that mosaics deteriorate mainly as a result of environmental conditions, and that therefore shelters protecting the mosaics from the environment will slow their deterioration or may even stop it.

Based on this assumption, technicians, designers and architects are commissioned to design protective shelters, and they become the main decision makers. Naturally, their considerations are primarily towards the aesthetic and form issues — assuming that the functional objective is automatically solved by just putting up the shelter.

Whether shelters are needed at all, whether they provide the needed protection, has still to be proven — and the most logical way to prove it would be by choosing several existing shelters and evaluating their performance. Surprisingly, it is an impossible mission since published papers or studies addressing the issue are non-existent [1].

[1] The only researches I know of are currently being carried out by Zaki Aslan, a Jordanian architect,

Therefore, the only way to do it would be by initiating a study the main objective of which would be "the performance of shelters at archeological sites" and the main consideration and criterion "the conservation of the protected elements".

Since such a study does not exist, and I do not even know of the existence of guidelines for the design of shelters for mosaics which consider conservation as an objective, the best thing that I can think of is suggesting such guidelines and design considerations.

The guidelines could be extremely simple: "Provide the most favourable environment and protection for the preservation of the mosaic".

This is true and correct in theory. The reality is that since we do not know scientifically what is causing the decay of mosaics, we cannot say what is the most favorable environment for its preservation. Understanding via a scientific process what are the causes of deterioration of mosaics will be therefore the first step towards the preparation of guidelines for shelters, or for any other means for the protection of mosaics.

A theoretical process which will be described here, will have to be implemented on several real sites in order to achieve a methodology and recommendation.

A thorough documentation will include the study of the bedding of the mosaics, the layers and the materials it is made of. A study of archeological layers or the geology under the mosaics might also be needed. A survey of the floor surface, including a description of all the different materials of which the tesserae are made (geological identification) is also necessary.

A documentation of the history of the mosaic: When was it made? For how long was it in use? Is there any evidence of "traumatic" events such as iconoclastic activity, ancient repairs, later construction on top, damage caused by the destruction of the building that it is part of, fallen stones, beams, fires or vandalism.

The mosaic's recent history: When was it first exposed? How was it excavated and how was it cleaned? (Water, acid, hard brushes, chisels, scalpels and others are all practices known to be used by archeologists) Where there any recent conservation attempts and if so, what are they?

Historic, graphic, photographic and verbal documentation has to be collected. The mosaic will have to be documented graphically and photographically, using the most accurate and detailed methods available.

A thorough condition recording and study will have to be conducted. This study will cover issues such as decay of tesserae, salt deposits on the floor, detachment from bedding, cracks through bedding, hollow areas under floor surface, damage to the floor edges, losses and lacunae. The topography of the mosaic surface must be documented.

Macro and micro plant organisms will have to be detected and documented. Simultaneously, environmental data collecting will take place. The needed data will be collected during the period of at least one year, and will cover the following issues:

Temperatures of air and mosaic (including surface and subsurface), sun radiation.

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as part of a doctoral thesis at the Institute of Archaeology University College, London, and by the Istituto del Restauro in Rome.

Relative humidity, condensation, subsurface moisture at different depths, rainfall — quantity and directions: how much is falling directly on the mosaic and how much is surface run off from the surroundings; wind and wind blown particles, snow, frost, freeze, thaw cycles and possibly other environmental data.

A condition assessment will be done based on the full documentation, and correlated with the environmental data. This, together with comparisons between decayed mosaics and less decayed ones, in the same areas, should provide sufficient indicators for the understanding of environmental causes of decay of *in situ* mosaic floors.

From this point we should go back and from understanding the causes of decay we should be able to determine the best environmental conditions for the conservation of mosaics.

These conditions should be created whether by shelter or other means — and they should be the primary conservation related guideline for the design of shelters. With this knowledge and methodology the performance of existing shelters can be evaluated.

As long as we do not go through such a process we will keep designing shelters based on assumptions, and even cause damage to mosaics through the creation of wrong environments.

The GCI launched several projects, which will deal with shelters and which will use the methodology described above.

One project is specifically designed to study the causes of decay of mosaics and it is being conducted at the moment in Tunisia and Israel. Another project deals with shelters on Maya sites and although not for mosaics, it will follow the same methodology.

The results of the mosaics project will hopefully lead to the better understanding of why *in situ* mosaics decay — and as a logical by-product how to slow down the decay process and if by sheltering, what should be the guidelines for the design of better shelters.

To illustrate the fact that with the existing knowledge we are unable to evaluate the performance of shelters nor provide guidelines for their design, I will mention several cases.

Most of these cases are from Israel, where the professional situation of mosaics conservation, as well as of the awareness, is far better than in most countries with mosaics. Considerable resources (never enough) are devoted in Israel to mosaics conservation, construction of shelters, maintenance and training — and that is exactly where my big doubts were born. In spite of huge efforts, mosaics keep deteriorating and shelters keep being designed and constructed without a clear understanding of their future performance, what exactly they should protect mosaics from and whether a shelter is the best and right protection. This should not be construed as criticism, but rather as an illustration of a situation in a country where there is a certain knowledge, method, experience and awareness. What happens then in places where all this is lacking? Being one of those who designed, guided design and approved of shelters, I feel that I am an adequate professional to ask these questions and leave doubts in our collective knowledge.

Here is a partial list of shelters, with a few comments:

Hefziba - Beit Alpha synagogue: A closed building from the 1930s with a walkway around the mosaic and video film projected on one of its walls. Regular maintenance of the mosaic, but also signs of deterioration.

Beit Shean Kiry Maria monastery: Closed shelter, built in the early 1950s, of concrete, steel and an asbestos roof. Several floors badly deteriorating, others less. No regular maintenance, and the site is closed to visitors since the late 1980s because of deterioration (partly as a result of pouring water to make patterns visible). This site was chosen by GCI for the decay-sheltering research.

Maoz Hayim synagogue: Closed shelter from the 1960s, built primarily of corrugated iron. The mosaics are deteriorating, no regular maintenance, nor public visits.

Nahariya monastery: Closed building from the early 1980s, built of laminated wooden structure, concrete blocks, corrugated fiberglass roof, and Plexiglass windows. Visitors only by appointment and in the last years no regular maintenance.

Zippori - villa of Dionysus: Closed building from the early 90s — serves as protection for the mosaic and as interpretation center. The first with controlled climate and special illumination — but mainly for the presentation and public comfort and not for conservation reasons. Signs of deterioration of the mosaic, which was lifted and re-laid.

Masada - western palace: Open shelter, on top of high stone walls, built in the late 1960s. It seems that the main deterioration is the result of water being poured on the floor and greasy materials applied on it — all in an attempt to improve visibility. The floors underwent restoration in the mid 90s and it remains to be seen whether they keep deteriorating. The site is regularly maintained.

Sussia - synagogue: Open shelter, but with relatively high stone walls around. Built in the early 1970s and modified in the mid 1990s. Wooden gables with iron tension rods, originally with asbestos roof. In the 90s the roofing material was replaced with ceramic tiles, an improved drainage system was installed and the roof was extended. The mosaic is deteriorating.

Maon Nirim - synagogue: Open shelter from the late 1970s, without walls, modified in the early 90s. The shelter is built completely of exposed concrete and has a flat roof. The mosaic, which was mostly lifted and re-laid, shows bad deterioration, mainly of the glass tesserae. In the 90s the drainage was improved and an elevated metal walkway built around the floor. No regular maintenance.

Hammat Tverya synagogue: After many years of standing exposed, an open shelter was constructed in the mid 90s with very low walls. Made of a laminated wooden structure and a copper roof. It includes a walkway for visitors and some presentation ideas behind its design. There is no way to learn whether the shelter slowed down the deterioration rate, which was not high to begin with.

Ein Gedi synagogue: A tent-like tension structure built in the mid 90s, made of metal posts and cables, concrete bases and impregnated fabric. The shelter provides presentation opportunities and protection for visitors from strong sun radiation.

Zippori - lower villa: Open shelter, built in the mid 90s, made of laminated wood and low, partly reconstructed walls. The central mosaic underwent extensive *in-situ* conservation work, and it remains to be seen whether thanks to the shelter it does not deteriorate.

Caesarea - public building: Temporary, wooden, open shelter, over a mosaic covered with geotextile and basalt gravel. Built in the second half of the 1990s.

New shelters in different phases of design are in Lod, Kursi monastery, Shavi Zion church, Zippori synagogue — all would benefit from methodology and knowledge regarding the decay of mosaics and the role of shelters in their presentation.

Some interesting cases are of mosaics without shelter — some of which are in good condition and other badly deteriorated — such as the different mosaics of the Martinius monastery in Ma'aleh Adumim, the different churches in Mamshit, the mosaics of the early Moslem palace of Kh. Minnim (Minyah) — which is another case study of the GCI project.

An extremely interesting case to be studied is that of the mosaics of Hisham's palace from the Umayyad period in Jericho (Palestine). That is a case where part of the mosaic is in closed shelters, another one exposed and the majority covered with soil. The comparison of the state of conservation of the different sections could be very useful for the understanding of the decay process.

I assume that most readers could come up with their own set of examples as a replacement to illustrate the situation as shown with those from Israel. I would just like to mention a few examples from Italy, mainly of unsheltered, famous cases, which do not seem to be in very bad shape: Some of Ostia's mosaics which are exposed and visited by millions, some of the mosaics of the Baths of Caracalla in Rome — exposed and walked on by millions, some of the mosaics in Pompeii (such as the ones at the Villa dei Misteri) or the mosaic floors in Aquileia in Northern Italy, where it seems that the ones under the shelter (closed building) are sometimes in worse conditions than those exposed to the elements. That is another case the GCI hopes to use for the study.

Although I am sure that some of the sheltered mosaics would not have survived if unsheltered, some of the shelters mentioned above can be truly evaluated regarding their effectiveness in preserving the mosaics, without a systematic methodology as described, or similar. We suggest that the methodology that is being developed by the GCI, together with partners from Tunisia and Israel, should be adopted by others, namely, studying the effect of different climatic conditions and different mosaics composition on their state of conservation and decay. This will lead to better understanding of conservation means, including shelters, and it will make the evaluation of shelters a possible mission.

DISCUSSION

Bakirtzis: [trans.] Thank you very much, Giora (Solar), for your very detailed and in-depth, useful presentation on shelters. You brought up four points. First of all, there was a definition of the characteristics of a shelter; secondly, you analysed the use-

fulness of the shelters; third, you classified shelters in three categories, depending on their duration — temporary, semi-permanent, and permanent — and you concentrated on the last group, the permanent shelters, giving many examples from this category of permanent shelters and commenting on the characteristics of this category; fourth, you ended with a series of creative questions which dispute the usefulness of shelters, and these questions are very creative for the promotion of this issue.

Guidobaldi: I am very pleased to express my appreciation for this communication. It is the first time that I have heard a discussion of shelters where the aesthetics were not mentioned first. This is a considerable step forward; you showed many examples without any comment on aesthetics, or only slightly sarcastic comments such as: "this is all right" and "this is okay." I really think this is very important. We have to remember first that the shelter is to protect the mosaic, but the restoration is sometimes very exaggerated. In any case, of course, a shelter can be helpful, like the shelter of Mr. Bakirtzis in Philippi, because in this case they give an indication of the plan of the monument that was overlain by another, and this can be helpful. But the first task for us is really what you said — to find a way of protecting the mosaic more adequately, and then, in the second step, to see to the aesthetics and to give the work to the architect.

Solar: I would like to add to the question of aesthetics. Of course, no one is more expert than the others when it comes to the question of aesthetics. But for me, being an architect, I can say that architects are dangerous, because when you let them decide they have to leave their stamp. Otherwise, who needs them? That is why specifications have to come from others, and you always have to remember that what is important is the site and the environment. And of course the shelter should never steal or play the main role and become the main element on a site.

Sivan: Concerning the design of shelters, sometimes we have a problem, as in Paphos, where we have a large amount of mosaics. My question is whether we have to look for a common denominator for all the shelters, or should each shelter be different? Are you afraid, if we are not looking for a common denominator, that it may be a good exhibit of mosaics, but that we will lose the site? Even if we have well designed shelters, one of the main problems on sites where there are large numbers of mosaics, is how to deal with the archaeological context? Because sometimes we protect the mosaic, which is only one part of the building, we may lose the general context.

Solar: It is a matter of case by case, but generally, and Renée (Sivan) knows this well, the idea of a shelter was developed — the idea was developed, not the shelter — in Zippori of a modular shelter for a large site with many mosaics. If you do not necessarily want to express a specific building by the shelter, some kind of neutral, functionally good shelter which could be extended was developed as an idea, but it was never executed for various reasons. The idea is worth further study.

Melucco Vaccaro: I should like to raise a particular topic. Yesterday, when we were visiting the House of Dionysos at Paphos, Dimitri (Michaelides) told us that during the hostilities in 1974, owing to the nature and the materials of the shelter, a fire developed; thus the presence and nature of the shelter added further damage to that suffered in antiquity. We live in the Mediterranean; it is a seismic area where, unfortunately, earthquakes and other troubles occur. Have you any suggestions concerning the requirements for shelters, to minimize extreme hazards such as earthquakes and other events?

Solar: The only thing I think that is worth saying at the moment is that these things should be taken into consideration in any place that protects people or buildings. We also have to remember that shelters are not maintenance free. Without maintenance, the best shelter which will stand strong earthquakes will start to rust, and the rust will show on the floor later. So, there are many considerations. This only proves again and again that the design of shelters is not someone's professional property; it must be a team effort, and all aspects should be taken into consideration. I don't know if there are guidelines anywhere. Sometimes on sites in Israel, at least, because a shelter is a building, it has to be built according to building regulations. And in the building regulations there are, of course, regulations pertaining to earthquakes and other hazards. But in many cases a shelter is considered as a temporary thing, like a tent, and then those aspects are not considered.

Michaelides: My comments are really a sequel to what Renée Sivan said and also to the remarks of Alessandra Melucco. I will start with Alessandra. I agree with what she said, and one thing we must not forget is that the shelter cannot function by itself. People who design shelters should think of how things are going to happen — not only maintenance of the shelter but how things are going to function within it. This came to my mind yesterday when we were looking at the mosaics of the House of Dionysos. To all intents and purposes, the shelter, whether we like it or not, functions to protect the mosaics. But we are in a country with a lot of dust, and this is a general question that we have to face when we are talking about protecting mosaics *in situ*. In England or in Switzerland, not only because they are tidier than we are, their mosaics and shelters are very clean. You can see that the colours of the mosaics are beautiful. They have no dust. We have dust. We have an eternal problem in our own houses, let alone in the shelters in the open air. Nobody has thought how to deal with this dust. Either you have to sweep the mosaics and mop them every day to be visible, or you gradually let them fade away under dust. This is a problem that people who design shelters should bear in mind. Turning to what Renée said, I agree with her that we need a unified idea about shelters in an area with a lot of mosaics. To play the devil's advocate, take a place like Paphos, which you did not have much chance to see yesterday, but normally you look at Paphos from above before you reach it. We already have maybe seven shelters at the site, and we know of at least another twenty-eight houses that have as many mosaics as you saw yesterday, not to mention the early Christian basilicas. Now, if the money

appears suddenly and we decide to roof them all, do we make a uniform shelter all across the city? The city was never uniform. It grew. Roofs change from period to period. I know it is an impossible question that I am asking, but it is something we have to think about.

Weidmann: [trans.] I would like to return to the fascinating problem of shelters. We talked about architects' responsibilities to create a shelter — whether temporary or final, it is really rarely permanent — you have to carry out plenty of conservation because the shelter changes the conditions of the artifacts it is protecting. I think that the most important position on the team is that of the climate engineer, who should have participated in the prior studies, and whose work and results will seriously affect the design. They are very often much less costly than the architect, both immediately and as far as consequences are concerned.

Stanley-Price: First a comment, and then a question to Giora (Solar). He called for the need for guidelines and said that at the moment we are not in a position to provide them. I think as a step towards them, if we are ever going to have a systematic approach to the question of protective shelters on archaeological sites, we need to get away from such terminology as temporary, semi-temporary, semi-permanent and permanent. Are those labels that we put on those structures when we go to a site and look at them, or are they labels put on the structures by the people who built them? I think the people who build the shelters should state very clearly how long the expected lifespan is of that structure. For instance, the hexashelter over the Orpheus mosaic in Paphos, which most of you saw yesterday, was designed to have a life of two years. The fact that it is still there and successfully functioning seven years later is all to the good, but that is because of broader political considerations, which means that it has not been replaced yet. And I think we should think about defining very carefully what the expected lifespan is of any structure that is built and making it known, and maybe even more useful than talking about the expected lifespan is to talk about the expected half-life. So, once the half-life has been passed, it puts a kind of onus on those responsible for the site to remember that they had put a certain figure on the expected life of that structure and that planning for the replacement of it or renewal of it, or at least control of it to check that it is still functioning successfully, should be immediately operationalized. That is a long question that I would like to put to Giora, followed by a very short one. You said that you were not always sure that visitors should not be allowed to walk on mosaics. Under what conditions do you think this could be allowed?

Solar: I will start with the second question. The question is short, but it is not, in fact, easier. I think it would be very pretentious, in my view, to say under what conditions we can allow people to walk on mosaics. When I finished my talk saying let us be scientific and study, I think we have to study, and this is one of the questions we have to study. So, if we come to the conclusion that if a mosaic is lifted, relaid on a hard slab, put back, then you can walk on it, then we should ask if we want

that, because we advocate *in situ* conservation, and relaying it is not *in situ* treatment as far as I am concerned. There may be other cases. There may be a mosaic which has excellent bedding and has a part, a very clear part, which is made of very hard stone. We know that even hard stone will wear when thousands and millions of people walk on it. But maybe in some parts, as in Piazza Armerina, you can put carpets on it; you walk on the carpet and not directly on the mosaic. Then you do not have the elevated walkways which become a very strong element inside the shelter and on the site. That deals with the second question, but it is something that has to be studied. Your first question concerns the lifespan of a building. In the case of a modern building, we do say what the lifespan is. It should exist for a longer time if it dies a natural death, but the lifespan is specified, and you are right. It should be specified for other shelters. And then we can still say if the lifespan is two years, then we call it a temporary. If it is twenty years, then it is permanent. And we should always have a maintenance and management plan because lifespan is always when the maintenance is the right maintenance, and if you do not have that, then the lifespan is shorter.

Corfield: On the idea of walking on mosaics, there are occasions when the ability to walk over a mosaic is either necessary or important, but it must be accompanied by a monitoring of what is happening to the mosaic, how much wear is taking place. We have been doing a number of studies in England looking at the effect of people on floors. And it can be a very severe problem, possibly needing occasional re-routing and so on. But returning to the way that we specify our cover building, let me be a little bit defensive of architects. Architects will do what you ask them to do, and if you only ask them to put up a building of whatever nature over the mosaic, and if you do not give them any other parameters to work to, then they will go away and they will use their imagination and they will come up with a wonderful memorial to their own ingenuity. We have to tell the architect what we want the performance of the building to be. We have to know ourselves what we want the performance of the building to be, what sort of environment we want to create within the building, what sort of ability we want to have to provide interpretation to the visitors, how we want the building to conform with the site, and work together with the architect to create the sort of structure that is going to give the best longterm conservation to the mosaic underneath. And perhaps this is a problem of having guidelines; it is rather like the museum designer picking up his copy of Garry Thomson's book on museum environment and reading through it and using it as a cookery book — we are back to cookery books again. Each mosaic or each site will have its own characteristics. We do not have the dust problems that Dimitri (Michaelides) has all year round, but we do have them in the summer, and it can be a problem. But we have to be able to define it and we have to be able to tell them, and tell them for the individual site, not just the generalities of it.

Anastassiades: [trans.] A shelter, whether we like it or not, is a structure, it is a work of art. Its purpose is to protect the mosaics. What would you prefer — an ugly-look-

ing shelter that does a good job, or an aesthetically good-looking shelter? We do not have to reach extremes, but we should not resort to ugly structures that do a good job but offer nothing to our aesthetic demands.

Solar: I think the answer is clear. But a very ugly shelter acts exactly the same as a very beautiful shelter. That is what attracts the eye. If it is extremely beautiful, and let us say that both perform the same, they are good, they protect what they have to protect; but if they are both extreme, one is very ugly, one is very beautiful, I believe both cases are wrong. Because what is important is the site.

Bakirtzis: [trans.] In your presentation, you referred to the shelters of Philippi, and Federico (Guidobaldi) spoke about them, and when I spoke on Thursday, various questions were posed. Today I am given the opportunity to answer these questions. You asked how the choice was made of the various shelters that we had designed and how we chose the fourth simple geometric solution. There were two reasons. Practical and aesthetic, if you like. The practical reasons were that the elements, the data that we had from the meteorological company in the valley of Philippi, the very strong northern winds that blow there in the wintertime did not allow the solution of a tent-like structure. The aesthetic reasons are that we reached a conclusion that within archaeological sites geometric designs are more neutral; they do not offend the unity of the sites and through their neutral shape they are more distinctive. So we preferred the geometric design to other solutions, of which, of course, there were many. And I would also like to make a further comment concerning the shelter museums, as you called them, the category of permanent shelters. Examples of museum shelters are the shelters in Vergina, west of Thessaloniki. The fact that the tombs there are under artificial hills has allowed these shelters to develop into a kind of local museum.

Guidobaldi: One very interesting thing in your communication, Giora (Solar), was your mention of shelters during excavations. Normally people talk about shelters after the restoration of the mosaic or something like that, and it is rare to hear them mentioned in the context of an excavation. I have seen many cases in which a storm occurred during an excavation, causing considerable damage to the mosaics in the course of excavation. So the provision of shelters during excavation is also a subject which should be taken into account. Another thing I want to bring to your attention is the hierarchy of things to be protected, depending on the function they had before. I am speaking about my *opus sectile* study, rather than mosaics. Particular kinds of mosaic were sometimes intended to be exposed in the open air, but *opus sectile*, in my opinion, was never designed for that. The thing to avoid is the deterioration of the *opus sectile*; in many cases the restoration is terribly intrusive and changes the nature of the pavement completely; they put a bar of brass inside, they make strange mortar and this is not the natural *opus sectile* any more. Everything is changed. In this case a shelter is unavoidable.

Nardi: We have often seen shelters that are so invasive, they are more attractive than the monument itself, and they become the monument itself. In many cases the maintenance of the shelter is more expensive than the maintenance of the mosaic. You made an excellent point that before a decision is made to build a shelter, the problem should be analysed and the objectives finalised to check if the shelter is the best solution. I think that this, coming from an architect, is very generous.

Piqué: I would like to continue Roberto (Nardi's) point. I think it would be really interesting also to assess the efficacy of the shelters, and to define some parameters that one could check before and after the implementation of the shelter, including, I was thinking, temperature, moisture content, events of condensation, both inside the shelter and also outside. Sometimes when I see shelters I wonder how the water that collects during rainfall is managed outside the shelter, the protected area. So, I would like to propose that it would be interesting — and this is something that Nicholas (Stanley-Price) actually said at the beginning of this meeting — to have as many people as possible following some parameter that we could define for assessing the efficacy of the shelters.

Lavagne: [trans.] I would like to add a point to what was said about a famous shelter which covered the Ara Pacis in Rome. You said that sometimes the shelter draws more attention than the monument it is supposed to protect. I would like to present this paradox, that the older a shelter is, the older it looks and it is this which attracts the eye. However, I have heard that the Ara Pacis shelter is going to be destroyed. The Municipality of Rome has opened a competition to make a new shelter for Ara Pacis. I am an art historian, and I protest! You are going to destroy a shelter that is dated and represents a certain design of shelters. So, you should provide another shelter to protect the first shelter.

Nicholas Stanley-Price and Gianni Ponti

Protective enclosures for mosaic floors: a review of Piazza Armerina, Sicily, after forty years

INTRODUCTION [1]

It is now over forty years since the decision was taken to preserve *in situ* the mosaics found at the Roman villa near the town of Piazza Armerina in Sicily. The villa is known locally as the Villa Romana del Casale. With the conclusion in 1954 of a series of excavation campaigns by G.V. Gentili [2], an area of over 2,000 m² of floor mosaics had been uncovered (Fig. 1).

The mosaics represent one of the largest and most spectacular exposures of late Roman mosaic floors from anywhere in the Empire. As a result, the villa features in almost every survey of Roman art and architecture. Its importance was further acknowledged with its inscription in December, 1997, on the World Heritage List of UNESCO. Further more, the measures taken in the 1950s to preserve the site have also been widely commented upon. The protective enclosures constructed over the mosaics are frequently referred to in discussions of techniques for the roofing of archaeological remains *in situ* [3].

In this paper, we evaluate some of the pros and cons of the solution adopted forty years ago at Piazza Armerina. We first consider the context of the decision-making of the

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[1] The research on which this paper is based was undertaken on behalf of the Getty Conservation Institute of Los Angeles, USA, as part of the preparation for the conference it organized in May, 1995, on "The conservation of archaeological sites in the Mediterranean region". We acknowledge the support of the Institute that made this research possible.

[2] G.V. Gentili, "Piazza Armerina. Grandiosa villa romana in contrada Casale", *Notizie Scavi di Antichità* 1950, pp. 291-335; *idem*, "La Villa imperiale di Piazza Armerina" in *Atti VII Congresso Nazionale di Storia dell'Architettura*, 1956, pp. 247-250; *idem*, *The Imperial Villa of Piazza Armerina*, Guidebooks to the Museums, Galleries and Monuments of Italy, 87 (3rd English edition), Rome 1966, with other references.

[3] E.g. S. Ranellucci, *Strutture protettive e conservazione dei siti archeologici.* I Saggi di Opus, 5. Dipartimento dell'Architettura e Restauro dell'Università "G. D'Annunzio", Chieti, Pescara 1996, pp. 88-90, 125-126; H. Schmidt, *Schutzbauten*, Stuttgart 1988, pp. 100-105; J.H. Stubbs, "Protection and presentation of excavated structures", in N.P. Stanley-Price (ed.), *Conservation on Archaeological Excavations with particular Reference to the Mediterranean Area*, ICCROM, Rome 1984, pp. (79-96), 87-88; F. Minissi, "Ipotesi di impiego di coperture metalliche a protezione di zone archeologiche", in "Coperture a protezione di zone archeologiche", *Restauro* XIV, no. 81, 1985, pp. 27-240, figs 1-2.

1950s. It is often difficult to reconstruct why certain decisions were taken forty years ago, but fortunately, in this case, we have contemporary accounts published by some of those involved[4]. We then assess from today's perspective the benefits and the drawbacks of the Piazza Armerina enclosures for the conservation *in situ* of mosaic floors. Finally, we comment on the impact that the solution adopted in the 1950s has had on the interpretation of the site by visitors.

DECISION-MAKING IN THE 1950s

The solution adopted to conserve the mosaic floors *in situ* was the result of discussions that took place in the mid-1950s. The main figures involved were G.V. Gentili, the principal excavator of the site; L. Bernabó Brea, the local Soprintendente for Antiquities; Cesare Brandi, Director of the Istituto Centrale del Restauro in Rome, and Franco Minissi, an architect who had begun to specialize in the preservation of historic monuments and the design of museums.

The three main options under discussion were those still debated today when mosaics have been excavated: to rebury them; to conserve them *in situ*; or to detach them and transfer them to a museum. There were already precedents on the site for the first two options. In much earlier excavations, both Pappalardo[5] and Paolo Orsi in 1929-30[6] had backfilled the mosaics that they had uncovered[7].

Subsequently, Cultrera[8], following his complete excavation of the Three-apsed Hall (Fig. 1, Room 57a) in the 1930s, decided upon a policy of visible conservation *in situ* of the spectacular Hercules mosaic found there. A roof was erected over the Three-apsed Hall in 1941-42[9]. Designed by the well-known restoration architect, Piero Gazzola, its shape followed the excavated ground-plan of the Hall.

The roof was a wooden frame covered with clay tiles supported by massive brick pillars[10]. The curvilinear walls of the building were restored in part to help support the

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[4] C. Brandi, "Archeologia Siciliana", *Bolletino del Istituto Centrale del Restauro*, 27-28, 1956, pp. 93-100; F. Minissi, "Protection of the mosaic pavements of the Roman Villa at Piazza Armerina", *Museum* 14, 1961, pp. 131-132.

[5] L. Pappalardo, *Le recenti scoperte in Contrada Casale presso Piazza Armerina*, Piazza Armerina 1881.

[6] P. Orsi, "Romanità e avanzi in Sicilia. Piazza Armerina", *Roma* 12, 1934, p. 255.

[7] For a fuller account of the many interventions at the villa of Piazza Armerina and the issues that they raise, see N.P. Stanley-Price, "The Roman Villa at Piazza Armerina, Sicily", in M. de la Torre (ed.), *The Conservation of Archaeological Sites in the Mediterranean Region*, Los Angeles 1997, pp. 65-84.

8. G. Cultrera, "Scavi, scoperte e restauri di monumenti antichi in Sicilia nel quinquennio 1931-1935", *Atti della Società Italiana per il progresso delle scienze*, 2, fasc. 3, 1936, p. 612; *idem*, "Sicilia, Piazza Armerina. Notiziario di scavi, scoperte, studi relativi all'Impero Romano", Appendix to *Bollettino Comunale di Roma* 68, 1940, pp. 129-130.

[9] Stanley-Price 1997, fig. 8.

[10] F. Minissi, *Conservazione dei Beni Storico Artistici e Ambientali. Restauro e Musealizazzione*, Rome 1978, fig. 179; Gentili 1966, fig. 1.

new pillars. The design was later criticized by Cesare Brandi who thought it made a sumptuous Roman room look like a hayloft. As for visitors, their only options to see the mosaics were either to walk on them or to climb a ridiculous wooden tower (reminiscent of a minbar in a mosque, as Brandi put it) that had been built at the entrance of the shelter [11].

Whatever the merits of Gazzola's protective roof, the area of the Three-apsed Hall had by the 1950s been left isolated by Gentili's extensive excavations. A much larger-scale solution was now needed and Gazzola's roof was eventually demolished.

In 1956 Brandi described in some detail the arguments that led to the enclosure solution for the Piazza Armerina mosaics. The option of removing them all to a museum seemed out of the question for a number of reasons: the very number of mosaics; the need to construct a purpose-built building to accommodate such immense mosaics as that of the Great Hunt (a floor *c.* 70 m long filling the Great Corridor, Fig. 1, no. 36); the dreary prospect of a museum containing only mosaics; and the lack of interest that the site would present once the mosaics had been removed. On the contrary, he maintained, they should be preserved *in situ* but covered to prevent deterioration. Others had proposed a total reconstruction of the site along the lines of Pompeii and Herculaneum; but this — so Brandi argued — would have led to a complete falsification since, unlike those two sites, the walls of the villa were poorly preserved for the most part.

Brandi was therefore of the opinion that the mosaics must be preserved *in situ* so that they were not exposed to humidity (through infiltration or capillarity), nor to direct sun, were not walked upon, and were not rendered invisible in any way by walkways erected over them. His solution was to propose that visitors walk along the tops of the walls, which were anyway in need of stabilization.

As for the protective shelter, having scathingly dismissed Gazzola's design of roof for the Three-apsed Hall, Brandi declared that there were only two alternatives: a huge dome or roof in reinforced concrete, or roofs of a light transparent material. Excluding the first alternative as equivalent to enclosing the ruins inside a car showroom, Brandi opted for a non-monumental design that left the ruins clearly visible.

This was the reasoning that led to the design by architect Franco Minissi of the protective enclosures that are to be seen today (Fig. 2). It was implemented in the years 1957-1960 and consists of a lightweight steel skeleton sheathed with translucent panels of plastic material. Again we are fortunate in having a contemporary account by Minissi of his design aims [12]. These were:

1) to form anew (not reconstruct) the areas of the rooms containing mosaics;
2) to protect the mosaics from the weather, while retaining maximum light;
3) to enable visitors to see all of the interior of the villa without walking upon the mosaic floors;
4) to add to the original structures only construction forms and materials that were obviously new, while preserving the integrity of the ancient masonry.

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[11] Brandi 1956, p. 97.
[12] Minissi 1961.

The plastic material used was a slightly clouded perspex laminate (3.2 mm thick), manufactured by ICI in the United Kingdom. Its advantages were that it was:

1) completely translucent, but cut out rays of the sun
2) waterproof
3) of low combustion
4) mouldable to any shape required
5) unbreakable, and
6) resistant to strain (for instance caused by the frequent snow in winter).

Minissi emphasizes that the structure is easy to maintain, and everything is reversible. As he has said, "everything could be dismantled with a screwdriver" (interview with the authors, October, 1994).

REVIEW OF PROS AND CONS OF THE ENCLOSURE SOLUTION

There is no doubt that the enclosures have allowed the mosaics to be conserved *in situ* and to be enjoyed by a large number of visitors. They are undoubtedly in better condition than are mosaics that have been left exposed to the elements. As with any such building, recurrent maintenance and replacement costs were to be expected. The materials used, especially the perspex plastic material, have discoloured and deteriorated with time, with the result that in 1972 and 1986 large sums were spent on materials replacement (information from the Soprintendenza Beni Culturali ed Ambientali di Enna).

A problem that the enclosures created and that has still not been solved is the "greenhouse effect" of a translucent structure of this design in the hot Sicilian climate. Both Minissi and Brandi had been fully aware of this potential problem and had proposed air-conditioning of the structure, but no funds were available for this.

In order to reduce the internal heat build-up, Minissi constructed the walls partly of corrugated perspex sheets forming fixed louvres, and partly of slats similar to venetian blinds (Fig. 3). Some of the wall panels could be opened for ventilation, making the most of local breezes. Flat false ceilings were installed with the aim of reducing heat transmission to the rooms below [13].

These ventilation measures have not been successful in preventing high temperatures inside the enclosures. There is no ventilation of the attic spaces above the false ceilings which, it has been argued, may actually have worsened the problem of internal heat build-up [14]. Most of the vertical wall panels in corrugated perspex have been substituted

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[13] Sketches of Minissi's original design for the enclosures were published in *L'Architettura* (Rome). Those for the fixed louvres of the walls and for the overall roof plan are reproduced by J.M. Fitch, *Historic Preservation. Curatorial Management of the Built World*, University of Virginia 1990, figure 14.4, nos. 9 and 3.

[14] M. Scognamiglio, *Piazza Armerina: Villa Romana del Casale*, unpublished report, Palermo 1992.

with panes of clear sheet glass in response to the need for materials replacement over the years. The clear sheet glass has increased the heat build-up inside the enclosures, despite the installation of additional vents to the outside. A study of the internal microclimate of the enclosures throughout one year has confirmed the extreme fluctuations of temperature and relative humidity that experience suggested [15]. These continue to have negative effects on both the archaeological remains and on the visitors to the site.

The fluctuations of temperature and relative humidity are presumed to affect the mosaics and building materials through causing cycles of soluble salt crystallization and the expansion/contraction of materials [16]. Problems have also arisen through the difference in behaviour between the original construction materials and the cement widely used in the past for making new supports for the mosaic floors and for integrating lacunae in them.

Whereas sources of moisture from above (rain and snow) are controlled by the enclosure, moisture from below — rising through capillary action — is not. There is an extensive system of Roman drains underlying the villa and the problems of rising damp are evident to today's observer.

As for the effect of the enclosures on visitors, the heat build-up inside them has sometimes been traumatic, with cases of people fainting and ambulances being called to the site (information from the Soprintendenza Beni Culturali ed Ambientali di Enna).

Only areas that contained well-preserved mosaics were roofed in the 1950s. In fact, not all the areas due to be roofed received a roof (e.g. Rooms 49, 47, 48 on Fig. 1). One that was deliberately omitted was the Basilica (Room 58) — perhaps historically the most important room of the whole villa. Minissi omitted it from his scheme because of its large span and therefore the cost of roofing it. He also thought that the marbles of the Basilica *opus sectile* floor would be more resistant to weathering than would the mosaics in the other rooms (F. Minissi interview, October, 1994). Only in 1977 was it finally covered in a project undertaken by the Soprintendenza.

EFFECT OF ENCLOSURE SOLUTION ON THE VISITOR EXPERIENCE

Minissi's design had two aims for the benefit of visitors: to convey an impression of the interior volumes of the rooms with mosaics; and to allow visitors to admire the mosaics without walking on them. It therefore included a system of walkways that follows the walltops; the walls were consolidated and reconstructed where necessary. The walkways enable the visitor to see all the excavated mosaics very clearly. In fact, it could be argued that the modern visitor sees more mosaics than a Roman visitor would have done, in much stronger natural light, and from a different (more elevated) perspective than was originally intended when the mosaics were installed.

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[15] A. Bartolotte and V. Caputo, *Piazza Armerina - Villa Romana del Casale. Indagine microclimatica*, unpublished report, Palermo 1991.

[16] Scognamiglio 1992.

The other aim, to recreate internal spatial volumes, seems to have been less successful. The system of walkways works so well in enabling visitors to gaze downwards at the mosaics that few of them seem to focus upwards to appreciate the nature of the building. The metal support structure for the roof was designed to suggest the lines of the walls and even the form of the capitals of columns [17].

Particularly problematic are the false ceilings. These were designed to reduce internal heat build-up but they also had an aesthetic goal, namely to stop shadows from the metal structures overhead from falling across the floor mosaics. Minissi placed the gridded ceiling materials at right angles to each other, to create a criss-cross pattern and so to diffuse the impact of the sun's rays below. In fact, the design has not been successful in this respect (Fig 4) [18].

Moreover, the false ceilings, although translucent, change the volumetric effect of the internal space of the rooms, rendering the intrados harder to appreciate. Thus a measure designed for conservation reasons — to reduce the solar gain — has conflicted with the aesthetic goal of re-creating an impression of an earlier built space.

It is important to stress that Minissi did not intend to convey an impression of the villa's overall volumes when seen from the exterior, only from the interior (F. Minissi interview, October, 1994). Even so, it is not surprising that many visitors assume that the enclosures were designed to re-create the original external form of the villa's buildings. For example, the preservation architect J. Marston Fitch, praising the solution adopted at Piazza Armerina, writes of "a transparent cage whose form would be a phantom of the masonry original... Externally, the effect is extraordinary: the villa looks like a photographic negative of the original. Internally, the translucent surfaces re-create the geometry of the rooms the mosaics once adorned while at the same time flooding them with diffused light" [19].

Even if not so intended by their designer, the enclosures constructed at Piazza Armerina do convey to visitors an impression of the external volumes of a Roman villa [20]. A more conventional approach to this task is by way of the three-dimensional scale model of the villa built in the 1960s (Fig. 5) [21]. It is instructive to compare the two media — on-site re-creation and scale models — as different methods of interpreting an ancient building for the public.

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[17] Stanley-Price 1997, fig. 15.

[18] Cf. *ibidem*, figs 13-14.

[19] Fitch 1990, p. 299.

[20] Cf. E. Cilia, "Esperienze di musealizzazione passate e presenti: Piazza Armerina, Rossomanno e San Francesco Bisconti", in B. Amendolea (ed.), *I siti archeologici: un problema di musealizzazione all'aperto*, Rome 1995, pp. 262-270.

[21] See W.L. MacDonald, "The Piazza Armerina Villa", Appendix in *The Architecture of the Roman Empire, volume 2. An urban appraisal*, New Haven and London 1986, pp. 274-283, figs 208-209. This model was built in 1960 by Michael Boyle (now School of Architecture, Arizona State University at Tempe) as part of an MA degree at Yale University (supervisor Professor William L. MacDonald). It is conserved on display in the Art Library of Smith College, Northampton, Massachusetts, USA. In the 1950s the National Museum in Syracuse had on exhibit another scale-model of the villa that showed the site as excavated, without any attempt at a reconstruction view apart from the re-erection of excavated columns.

CONCLUSION

The protective enclosures designed by Franco Minissi at Piazza Armerina have helped to preserve the mosaics *in situ* and have provided good conditions for visitors to view them. The mosaics are in much better condition than if they had been left exposed, and the conservation problems that are evident to today's observer have been the object of treatment in recent years. The viewing of the mosaic floors by visitors can sometimes be far from ideal, however, now that the number of visitors may reach 2,000 a day at peak periods. This was not to be foreseen, of course, in the economically depressed post-war period in Sicily. But the solution adopted in the 1950s for creating a visitor itinerary around the site is no longer adequate for the demands of today's mass tourism [22].

Moreover, it is a solution that focuses entirely on the mosaics and conveys very little idea of how a Roman villa functioned. The obligatory one-way route followed by visitors (Fig. 1) provides them with a remarkable aesthetic experience but it bears little relationship to the original movement patterns of the villa's occupants. But the aim in the 1950s was, as Minissi himself wrote, "to organize a special kind of museum round exhibits which were already in place" [23]. In this sense, the villa is a "museum of mosaics", an example of the "musealizzazione" approach to historic sites that Minissi advocated [24]. This is perhaps how the Piazza Armerina enclosures should be viewed today, as an illustrative example of a particular approach to the presentation of heritage sites to the public.

With the benefit of hindsight, it is easy today to criticize aspects of a solution decided upon more than forty years ago. But the options available today to an excavator of a series of mosaic floors have changed little from those considered at Piazza Armerina in the 1950s. Since then, conservation philosophy for excavated mosaics has veered away from their transfer to the protection of a museum and towards their preservation *in situ.* But the study of techniques for the successful *in situ* roofing or enclosing of excavated mosaic floors seems to have advanced little in the interim. The historical study of cases such as Piazza Armerina should contribute to a corpus of comparative material that in turn will help to indicate the directions in which new solutions may be found.

ACKNOWLEDGMENTS

We are indebted to Dott. Gianfillipo Villari, Soprintendente of the Soprintendenza Beni Culturali ed Ambientali di Enna for much help and for allowing access to unpublished reports in the Soprintendenza's archives; and to other members of the Soprintendenza staff who were helpful in providing information about the Villa: Dott.ssa Enza Cilia Platamone, Arch. Rosa Oliva, Dott.ssa Anna Bombaci, Arch. Claudio Meraglia and Geom. Liborio Bellone. In Rome, Architect Franco Minissi was very helpful in discussing his work at the villa.

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[22] Stanley-Price 1997.
[23] Minissi 1961, p. 131.
[24] Minissi 1978, figs 177-182.

DISCUSSION

Bakirtzis: [trans.] Your presentation is a historical review of previous projects, and very wisely you finished without drawing any conclusions so that we could discuss the conclusions. Studying previous projects and drawing conclusions, both positive and negative, from them is very useful.

Chantriaux-Vicard: [trans.] It seems to me that this example raises the problem of enclosed shelters, and depending on the country, one of the essential points we should spell out for architects is the need to have a closed shelter, which obviously means we must have thermal and hygrometric control, which can be expensive, and your maintenance system is not infallible and can break down. We know that poorly air conditioned, poorly regulated enclosed shelters can cause more harm than a simpler, less sophisticated structure. So, the question is to what extent are enclosed shelters really necessary, and whether a simple roof with natural walls which keep out the rain will not be enough?

Stanley-Price: You are absolutely right. As I mentioned, the enclosures can be ventilated, on request, by opening the vents on the walls and opening the panels at roof level, but experience has shown that it is not adequate. In 1982 a microclimatological study was made of the shelter, of the enclosures, by the Regional Conservation Centre in Palermo, which demonstrated very clearly the broad fluctuations and the extremes of temperature and relative humidity. So, the factual data have been available for some time.

Ben Abed: [trans.] I would like to return to what was said this morning and what Nicholas has just shown us. It seems to me that the example of Piazza Armerina is extremely interesting because it raises a problem of substance. If I have understood clearly, we want to keep mosaics *in situ*, to preserve them and also to show their original context. We want to give an impression of the overall design of the villa or monument, but from what I saw in the case of Piazza Armerina, which is typical of many other cases, as you mentioned, we see the mosaics — although it is not all that easy to see because of thousands of tourists shoving at you from behind — but at least there are some drawings that specialists can look at. And then at the end you said that Minissi said that what he wanted was to create a sort of museum. You talked about 'musealization'. What is the difference? In a museum you have to maintain the roofs, air conditioning system, etc.; what is the difference between lifting the mosaics and placing them in a museum, which would be much less expensive, or to reconstruct or to use models and designs?

Stanley-Price: It is hard to disagree with your suggestions. I think we have to remember the climate of thought of the 1940s and 1950s, particularly, when the tradition was still to remove all paintings and mosaics to museums automatically. And Italian colleagues would know better than I, but I would imagine it was a courageous deci-

sion in the 1950s to decide to preserve the Piazza Armerina mosaics *in situ.* And one of the reasons Brandi gave against moving them to a museum was the practical one of the size of the galleries that would be needed in museums, assuming they would be put on the floor and not on the wall, and from that point of view alone it was hardly feasible. As I say, Minissi treated it and wrote of it as a museum with the exhibits already in place; his approach to the treatment of archaeological and historical sites is 'musealizzazione' — making museums out of them, and I think we have to consider the Piazza Armerina solution in the terms of the climate of thought at the time. I quite agree that nowadays it is not a solution that lends itself to contemporary ideas of conveying the importance, the meaning of a site of a Roman villa. It is an itinerary for the visitors which allows the best possible viewing of mosaics, and actually goes contradictory to the probable original movement patterns in the villa. But that was not the intention of the designers of the solution.

Palumbo: I have two comments. One is about the problem of two thousand or more visitors a day; I think that this is probably not the context in which to speak about it, but we are fast approaching the moment where we will not only have to conduct carrying capacity studies for many archaeological sites, but we will also have to take radical measures such as limiting the numbers of visitors that can be allowed per day or distribution of the visitors throughout the day to avoid concentrations in the early morning hours or early afternoon hours with zero visitors in between these peak times. For many sites this is a necessity right now. The other comment is about the 'musealization', which is obviously one of the considerations, but the site still lacks one of the basics for 'musealization' which is interpretation. At Piazza Armerina there is not one sign to provide any interpretation of how the villa worked, even the periods; there is no sign to indicate the date of the mosaics. There is no interpretation of what the mosaics mean mythologically. After many visits, the first time you could see a plan of the site was just last month, when there was a small exhibition about the restoration carried out after the vandalism which occurred about a year ago. And again that was out of context because the plan was meant to indicate where the damage was done and not to provide any explanation of the meaning and function of the villa itself.

Stanley-Price: There are many other aspects of the site of Piazza Armerina, but in this presentation I was limiting myself to the design of the protective enclosure, fitting into the theme of this session. But I agree that it also raises many other questions.

Bakirtzis: [trans.] I have a practical question for you. In the end have these shelters, these enclosures helped or damaged the mosaics?

Stanley-Price: There is no doubt that the mosaics are in much better condition now than they would have been if they had not been covered. To make any sort of statement about whether it has damaged the mosaics seriously, proper research would be needed. Obviously I have to commit myself to a certain extent. Walking around the site

one can see areas of damaged tesserae, possibly through causes of crystallization of soluble salts. And some work has been done in certain areas of the villa to deal with those problems. My overall impression is that the mosaics still look, to the visitor, in extremely good condition. And they were described as being in good condition when they were first discovered. Quite a lot of restoration was carried out in the 1940s and '50s. However, there are serious problems, particularly connected with the capillary rise of humidity from below, which was made very evident by a flood which filled the whole villa in 1992, a short report of which is in the *Newsletter* of the Committee for 1992. And the after-effects of that flood have exacerbated symptoms that I think already existed. In short, I think the solution has been effective, given the time that it was designed and that it has lasted forty years, but that does not mean that serious research work should not be undertaken to investigate the causes of the deterioration that one sees.

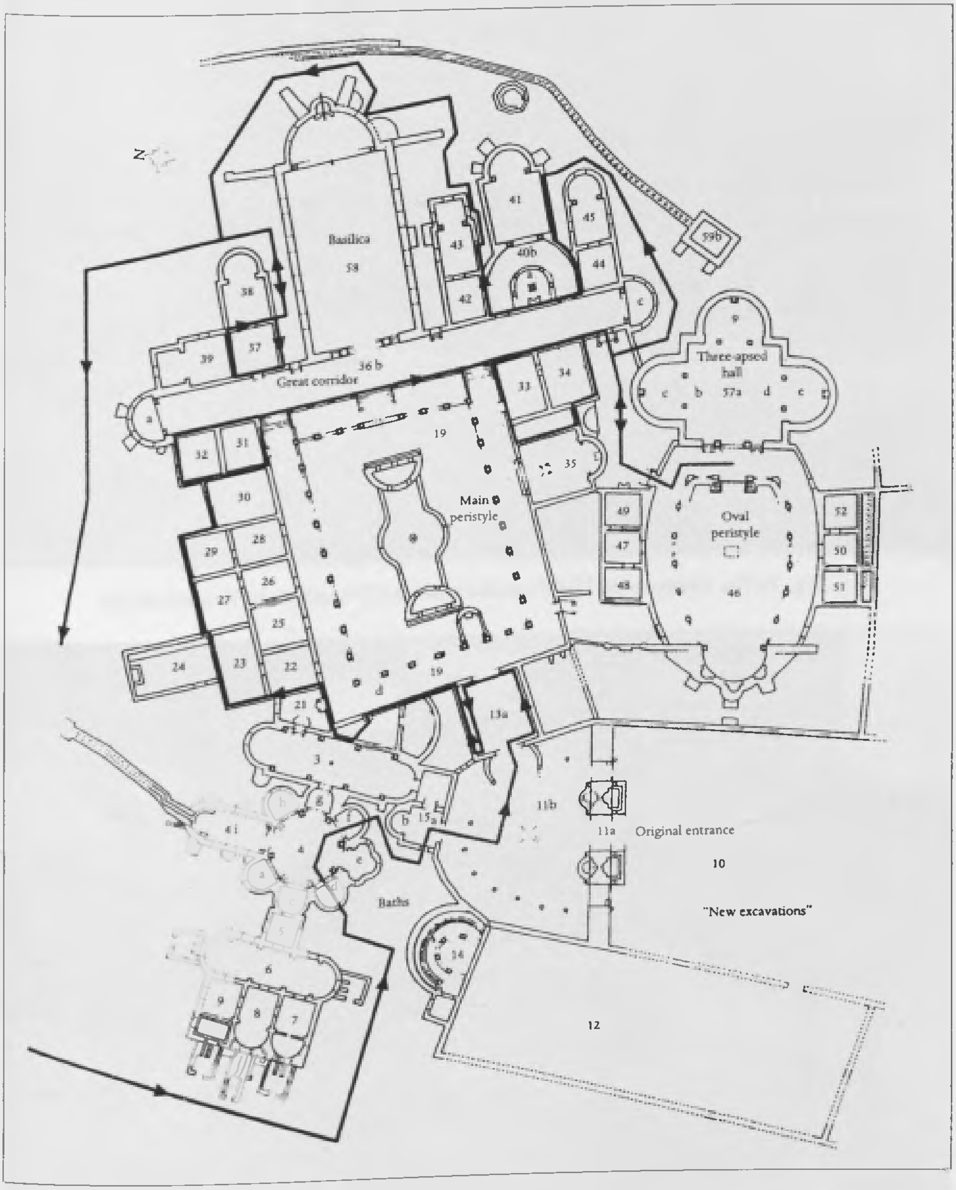


Fig. 1: Plan of the villa at Piazza Armerina (from Stanley-Price (1997) *op. cit.* Fig. 1, with permission).



Fig. 2: The Three-apsed Hall from the west in 1994 (photo by the author).



Fig. 3: Detail of protective enclosure, showing slatted wall panel (photo by the author).



Fig. 4: Shaft of sunlight on Great Hunt mosaic floor, 1994 (photo by the author).

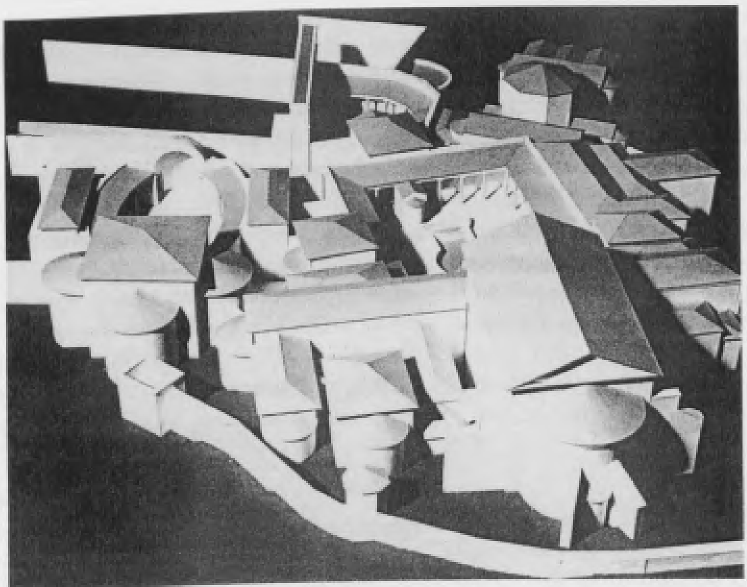


Fig. 5: Model of the villa at Piazza Armerina (from W.L. MacDonald, "The Piazza Armerina Villa", Appendix in *The Architecture of the Roman Empire, volume 2. An urban appraisal,* New Haven and London (1986), figure 208, with permission).

Maria Concetta Laurenti*

On-site protection of mosaics: covering and protecting archaeological remains

The preservation of archaeological finds *in situ*, especially precious and fragile finds like mosaic floors, stuccoes and wall paintings, represents an important contribution to culture and also increases the value of the archaeological area itself. But in order to realize this type of preservation, we often need architectural solutions that are harmonious with the site locations and appropriately designed to protect the artifacts.

In 1956 Cesare Brandi, art historian and founder of the Istituto Centrale del Restauro of Rome, said that the only way to preserve the precious mosaics at Piazza Armerina was to build just such an appropriate structure. The archaeologist Pietro Romanelli did not completely agree, however, and he declared that he was against any construction which altered excavated ruins [1]. At most he allowed a simple roof where it could not be avoided.

This ideological position was the expression of a long standing hostility between archaeologists and architects. Some inappropriate architectural projects for museums and the protection of archeological sites were partly behind this hostility [2]. Unfortunately this has slowed down investigation of this important subject and interfered with interdisciplinary joint studies by architects, archaeologists, restorers and scientists. In fact, in order to conserve and present excavated sites with precious and fragile wall and floor decorations, we have to know what materials were used and to what extent the ruins we are trying to preserve form a comprehensible picture. We also have to take into account the relationship between any conservation structures and their site, as well as the changes they are likely to provoke in it. These concerns call for constructive discussions between experts in the various disciplines.

In many cases, the roofs erected to protect archaeological sites during excavations have remained standing as permanent protection for the site, *in lieu* of a more adequate

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* M.C. Laurenti was unable to come the conference. Her paper was read by Antonella Altieri.

[1] C. Brandi, "Archeologia Siciliana", *Bollettino dell'Istituto Centrale del Restauro* 27-28, 1956, pp. 93-100; P. Romanelli, "La conservazione delle aree archeologiche", *Atti del VII Congresso Nazionale di Archeologia Classica*, Roma 1958, pp. 81-88.

[2] A. Melucco Vaccaro, "I nodi attuali della Conservazione delle aree archeologiche", *Restauro* 110, 1990, pp. 17-33.

form of presentation for the material finds. In these cases, the original structures, which were meant to be temporary, are hardly likely to fulfill their function of preserving the material and are often unsightly into the bargain. Even buildings planned for this specific purpose have not always been satisfactory. A modern monumental building, or a building designed to recall certain bygone rural or industrial structures, is often without any architectural merit and may even cause the deterioration of the remains it was intended to protect.

Recently, many conferences on the question of on-site shelters are convincing proof that it is an important concern [3]. In particular, the XII Convention at Bressanone was concerned with the problem of preserving archaeological sites. A recent course offered by ICR on the conservation of archaeological sites also examined the controversial questions of roofing and contact protection for archaeological remains.

The problem we are looking at does not admit of only one solution. Each case has to be studied on its own merits. In vast archaeological sites like Ostia, for example, it would be impossible to roof over large areas. Some areas will have to be covered, as Vanni Mannucci has done in *Regione V, isolato II* at Ostia, where he used wooden slats to roof the new excavations. Other solutions might be to cover mosaic floors during inclement seasons with materials which do not damage them. We have a recent example of this type of covering at Ostia, in the Baths of the Cisiarii, where stratified geotex and expanded clay mattresses have given good results [4]. However, where it is possible, we might want to reconstruct the roofs of the ancient buildings, according to accepted archaeological criteria [5], as was done at Pompeii.

As other colleagues have already pointed out, the preservation of archaeological areas cannot be limited to building shelters. This is just one of the many aspects of conservation. The question of conservation has recently attracted a lot of attention, also thanks to the resources which are being invested in excavation sites. As I have already mentioned, it is a question which needs the combined expertise of archaeologists, architects, and restorers.

The possibility of a permanent shelter, not simply a temporary roof during excavations, which will protect the remains and make them available to the public, should be carefully considered along with other choices. Clearly, when the archaeological remains include important floor and wall decorations, a permanent shelter will be necessary. This

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[3] *Proceedings of the Vth Conference of the ICCM, Conimbriga 1993*, Conimbriga 1994; Atti del I Convegno *I siti archeologici*, Roma 1988; *I siti archeologici*, Roma 1994; ICCROM, Roma, *La Conservazione sullo scavo archeologico*, Roma (1985); ICCROM, Roma, *Preventive Measures during Excavation and Site Protection*, Roma 1985.

[4] V. Mannucci, "Recupero architettonico e valorizzazione di un settore urbano degradato: la Regione V degli Scavi di Ostia Antica", in *Atti del I Convegno I siti archeologici, un problema di musealizzazione all'aperto*, Roma 1988, pp. 31 ff.; M. Bedello Tata and L. Spada, "Progetto di restauro per il complesso musivo delle Terme dei Cisiarii ad Ostia", *Atti del II Colloquio dell'AISCOM (Associazione Italiana per lo Studio e la Conservazione del Mosaico), Roma 1994*, I. Brangantini and F. Guidobaldi (eds), Bordighera 1995, pp. 229 ff.

[5] A. Melucco Vaccaro, 1990.

may be anything from a simple metal reticulate roof to a more sophisticated solution such as a tensor structure, the use of the still-popular polycarbonates, or various *containers* like those at Piazza Armerina or Akrotiri (Santorini).

The subject elicits stimulating discussions. Certainly, the architecture itself is an important element, especially on urban sites, or sites where the monument and the site itself interact, as they do at the temple of Apollo Epicourios at Bassae. On that site, the tensor structure which completely surrounds the temple serves to monitor the environment and the state of conservation of the temple [6]. Although it was planned as a temporary measure, it has in fact been in place for many years.

All these reflections lead up to a project planned by the Istituto Centrale del Restauro. The main objectives of this project are to identify environmental characteristics necessary for the correct conservation of a partially enclosed archaeological area, to identify which materials should be used in shelters planned to protect archaeological sites and study how excess water should be dealt with, and to identify what materials should be used for short, medium and long term contact protection of archaeological remains, so that they will not be damaged.

We can only reach these targets gradually. The first phase of the project is to collect all possible information about various types of shelters for archaeological sites, in order to create a data bank. Data to be included are the characteristics of the archaeological remains, the location of the site and its relationship to the surrounding territory, the artifacts, including a history of their conservation and information from the *Soprintendenze* about covering and roofing.

We will also examine possible projects for controlling the environment in partially enclosed archaeological sites.

The first site to be investigated is Castelleone di Suasa, where for many years the ICR has been involved in the on-site conservation of mosaic floors belonging to a very large house near the amphitheatre. The house, which is about 2,000 m^2, consists approximately of 35 rooms, 20 of which have mosaic floors belonging to three different building phases: the Republic (2nd century BC), mid-Empire (2nd century AD), beginning of the 3rd century AD. Very obvious repairs made with different materials show that the building was in use until the 4th or 5th century AD. There are remains of plaster painted in geometric designs and imitation marble which have been conserved *in situ* at the base of the wall, but most of the wall decoration fell into heaps on the floor (Fig. 1) [7].

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6 Y. Tzedakis, in *Proceedings of the European Cultural Symposium, Science, Technology and European Cultural Heritage*, Bologna 1989, Oxford 1991.

7 For the excavations at Suasa see P. Dell'Aglio and S. de Maria, "Nuovi scavi e ricerche sulla città romana di Suasa (Ancona)", *PICUS* VIII, 1988, pp. 73-156. For the work of the ICR see A.M. Ardovino, "Pavimenti romano-imperiali in opus sectile e altre tecniche a Suasa: Conservazione in situ", *Mosaicos no. 5, Conservacion in situ, Palencia 1990*, Rome, pp. 71-81; M.C. Laurenti, "Nuovi interventi a Castelleone di Suasa", *Atti del II Colloquio dell'AISCOM, Roma 1994*, I. Bragantini and F. Guidobaldi (eds), Bordighera 1995, pp. 241-248; C. Cacace, G. Capponi, M.C. Laurenti and N. Pietrini, "La protezione delle aree archeologiche: la Domus dei Coiedii a Suasa", *Atti del XII Convegno Scienza e Beni Culturali*, Bressanone 1996, pp. 411-420.

There is a project to conserve the archaeological remains and open them to the public, which includes a permanent shelter to protect the mosaics and painted wall decorations. Since the excavations began, the archaeological remains have been protected by coverings in direct contact with them. These are made either of non-woven material or of a fine mesh nylon net with expanded clay. There is also a temporary metal roof (Fig. 2). These two elements will continue to protect all the archaeological remains during the work of conservation and restoration and during the building of the permanent shelter. Different specialist architects, the restorers working at the site, the archaeologists who excavated the site and ICR scientists and conservators are all working together on this project. The construction of the shelter will begin in the Spring of 1997.

This construction has an irregular plan, dictated by the shape of the excavations (Fig. 3). The roof will stand 3.5 m above the floor and will be constructed of plates placed in such a way that they form a reticulate pattern in space. The depth of this roof construction will be 1.6 m. The spaces which were not originally roofed, like the tetrastyle atrium and an unidentified pool, will have special glass roofs, so that their particular functions will be apparent to the observer (Fig. 4).

The room with the polychrome Nereid mosaic is much higher than the other rooms. The sloping sides of the roof and the cornice of this room will be covered with weathered green copper sheets, to blend in better with the setting.

The project pays special attention to the joint between the roof and the foundations. The joints will be situated in places where they will not interfere with the archaeological remains. The supporting structure consists of pilasters of different heights, situated both inside the remains and along the outer perimeter, in positions mandated by the nature and condition of the remains themselves.

Here, technology is not used for its own sake — the architects do not want to make it an ostentatious element in the plan. Rather, they have used technology discreetly to produce a sense of airiness and space, so that it enhances the remains of the past, without overwhelming them.

During construction, the various operations for protecting the archaeological remains (wall plaster, mosaics) will be carefully controlled while the roof is being put in place. The plans for excavation, restoration, and protection of the site have been closely coordinated, in order to accommodate the variations in temperature and humidity which construction operations will inevitably cause to the various materials on the site. In particular, the areas where the foundation pylons will be situated will be closely watched for any sign of alteration. Every part of the archaeological structures involved in this work will be drawn, photographed, and catalogued with reference to material data and state of conservation. The information collected will allow us to plan any subsequent interventions and to limit any changes caused by the shelter itself.

The environment will be monitored over a whole year to determine the effects of the new structure on the archaeological remains. The shelter will allow us to check the climate underneath and the effects of the covering on the remains below. There is really no reliable way to check those effects except *in situ,* because material remains are so different in composition and state of conservation. By monitoring the environment we hope to understand better how it interacts with the artifacts, because this interaction is the cause

of all chemical, physical, and biological deterioration. In fact, deterioration begins when an object and/or its environment are subject to changes in temperature and/or humidity. Good conservation practices therefore require us to take samples and measurements of the climate under the enclosure and outside of it: temperature, relative humidity, air speed and direction, in order to describe the ìnteraction between the various remains and their environment.

When we are dealing with an archaeological excavation where different types of materials in different states of conservation occur together (for example stone, mortar, brick, painted plaster, glass mosaics, etc.), it is vital to understand the behaviour of the climate. By covering over the site, we may provoke important changes, like the greeenhouse effect, changes in evaporation rate, absorption rate, and condensation. Covered sites frequently have a problem with the water caused by condensation.

At the House of the Coedii, we will study the climate as each section of the shelter is set up, so that we can correct any problems as they arise. In particular, where two transparent domes will be inserted, we can compare temperature changes of similar artifacts exposed to different forms of sunlight: direct under the transparent domes and indirect under the roof.

The monitoring system will include external measurements (air temperature, relative humidity, wind direction, irradiation), measurements under the shelter (wind direction, air temperature, relative humidity, temperature of the covering on the under and upper sides, and temperature at floor level) and measurements in the excavated area under the transparent domes (intensity of light, temperature at floor level, relative humidity, temperature of the covering on the upper and under sídes).

While we are monitoring the environment, we will also be experimenting with different materials to be used for inner, lower ceilings (cork, wood, and other materials). We will also set up experimental panels along the outside walls of the house to protect it from the effects of wind (direct damage and transport of earth, pollens, dry leaves, etc.). Panels will also be used inside the house to articulate the spaces differently and hide the more unsightly elements of the high-tech construction. Another part of the project calls for the controlled experimentation of temporary protective coverings in contact with the remains, to be used during or after excavation, or together with the roof in inclement seasons. We will be testing various different materials which are now being used to cover archaeological remains, such as non-woven material and expanded clay (Fig. 5). We will test different layered combinations of these materials in the laboratory and on the site to see how much protection they actually afford. Some people think that this problem has already been solved, but we believe it should be investigated further under controlled conditions.

The second phase of the project will extend these types of investigation and experimentation to other sites with different characteristics. Two archaeological sites have already been chosen. The first is at Varignano, in Liguria, near the sea. It is a country villa, with a large and varied residential section, which has been partially roofed with two different types of roofing. The earlier section goes back to the 70s and used inappropriate materials, such as fibreglass. The later section is made of metal, which creates condensation problems. The second site is at Corfinio, in Abruzzo. This a mountainous area.

Here we have a large house from the Augustan period, partly roofed in wood. The roofing is in fact still going on, and when finished will reflect the original dimensions of the portico (Fig. 6). At ICR we are restoring a large painted ceiling from this house, which may be put in its original place[8]. Both these sites contain important mosaic floors which are still *in situ.*

DISCUSSION

In the absence of Dr. Laurenti, there was no discussion of this paper.

[8] G. De Palma, E. Mancinelli, C.S. Salerno and M. Valenzuela, "Corfinio: L'Aquila: località Piano S. Giacomo. Recupero di dipinti da una Domus romana", *Atti del XII Convegno Scienza e Beni Culturali,* Bressanone 1996.



Fig. 1: Castelleone di Suasa, Domus dei Coiedii, wall paintings and mosaic floors *in situ.*



Fig. 2: Castelleone di Suasa, general view of the excavated area, temporary protective materials.

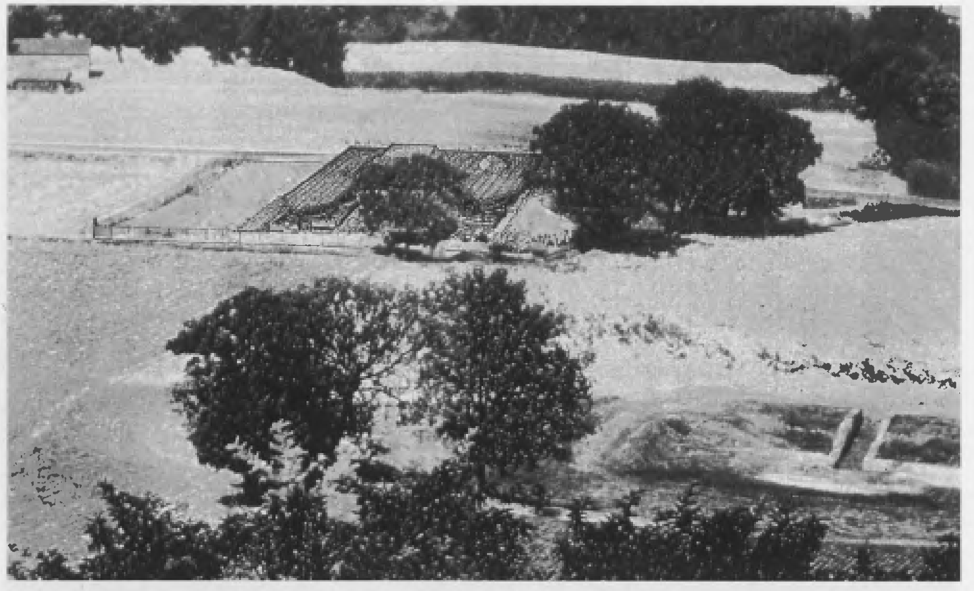


Fig. 3: Castelleone di Suasa, plan of the new permanent shelter.

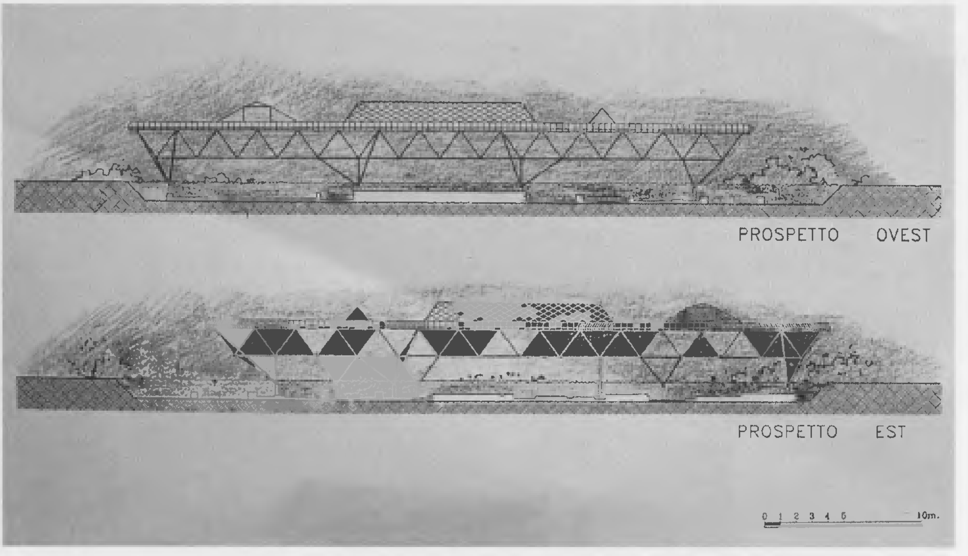


Fig. 4: Castelleone di Suasa, elevation of the new shelter, elevation front.



Fig. 5: Castelleone di Suasa, direct contact protection of mosaics, mattress of geotex and expanded clay.



Fig. 6: Corfinio, Augustan domus, construction of the shelter.

Ze'ev Margalit

The conservation of mosaics *in situ*: an alternative to shelters

Conservation of a mosaic *in situ* enables us to conserve it in its historical context. The theory and research of mosaics conservation *in situ* has developed extensively recently. Progress has also been made in convincing and explaining to the decision makers that the historical value of the mosaic is more than just the bi-dimensional artistic illustration. Its more important value is the aggregate of properties and effects on the mosaic since its formation, as an artistic and functional work until the present time.

The *in situ* conservation of a mosaic may be achieved by complex and sophisticated means including high level documentation, laboratory tests, analyses, models and experiments, analysis and study of ancient materials, analysis and study of historic work methods, use of modern equipment such as computers, optical systems, photography and data processing, use of modern and complex tools, and work planning and management using advanced techniques.

Very high standards have now been reached in all of these fields. But this has also created a conflict. After the professional and sophisticated treatment in conserving the mosaic *in situ* the mosaic has to be protected. To do so we may build a shelter, drastically affecting the general environment of the site with the building of a modern structure in very close proximity to important archaeological remains. This alteration of the site is in direct contrast with the ideas adhered to so strictly during the conservation of the mosaic. An imbalance is created between the level of the mosaic conserved *in situ* and the archaeological site on which the mosaic is located.

Theoretically speaking, if we did not have to build shelters over mosaics, most modern buildings serving as shelters which have been built on archeological sites would not have been constructed. The conservation architect could be free to make conservation and reconstruction design decisions freely and without any constraints related to the required shelters.

As far as we are concerned, any modern building built to protect mosaics comprises a modern intervention in the site; the question is how to minimize such intervention. The best method of mosaic conservation is to backfill the area in question, but clearly there are strong pressures from the tourist industry to expose more and more mosaics and for them to remain open for visitors. The wishes of the tourist industry and its clients have to be balanced against the conservation of the value of the site and its mosaics.

Clearly, every mosaic and every site should be evaluated on an individual basis. Thus, for example, on a site where there is a single, unique mosaic, and where this single mosaic represents virtually the whole site, it seems that the only solution is to build a shelter over it and display it to the public in the safest and most controlled manner possible. However, in the case of larger sites such as an ancient city or town with a multiplicity of mosaics of various standards, it may be advisable to develop a new approach towards the protection of the mosaics *in situ*. Such an approach would comprise the three following elements:

1. Quality rather than quantity. Only a few mosaics with a high intrinsic value should be displayed, while all of the others should be backfilled. If there are several mosaics which are similar in terms of geometric patterns, other subject matter or colour only those with the greatest significance should remain visible. As a result of this policy tourists visiting the site would see less mosaics, but those which they did see would be of the highest quality and also representative of the others no longer visible.

2. Periodic covering of mosaics. All mosaics should be consolidated and given all necessary treatment upon excavation. Thereafter a schedule should be established in advance for the exposure of selected mosaics. The cycle might involve exposure for several months every year, for several years or for another period of predetermined length. The planned exposure time of a mosaic should be determined according to its conservation condition and by analysis of the ability of each mosaic to withstand the weather conditions without any protection according to the season. Such analysis would serve as a basis for the data processing for the periodic backfill program for the whole site.

3. Interpretation. Didactic materials of high standard will be required to inform visitors about the large number of mosaics on the site, referring to those which have been backfilled. Such information should indicate the nature and extent of all mosaics on the site. This could be conveyed by signs and models, by imaging means using video or a computer and by indications on the site of the locations of the backfilled mosaics. A life-size illustration on fabric of the various mosaics might also be displayed at the relevant locations above the backfilled originals. Various combinations of methods are possible and additional methods may also be devised.

CONCLUSIONS

The use of the periodic covering method ensures a high standard of conservation of the mosaics, and it should also increase the public's awareness of the importance of conservation. The requirements of the tourist industry are met and the value of the exposed mosaics is increased. Exposure of rare mosaics for short periods of time may also provide

an added attraction for visitors. From the financial point of view the method is much cheaper than the building of permanent shelters. It provides maximum flexibility, it is reversible and new methods can be introduced at any time. More significantly it obviates the necessity for the planning and building of modern structures on archaeological sites, thus contributing to the preservation of the overall value of the sites in their broader perspective. The mosaics are treated as an integral part of the other archeological discoveries on the site, and their historical context within the site is conserved to the maximum extent.

DISCUSSION

Bakirtzis: [trans.] In a time such as the present, when technological solutions are easier than they used to be in the past, seeking solutions such as the ones proposed by Ze'ev (Margalit), which protect the clarity of archaeological sites are welcome. This presentation should provoke a wave of response.

Menicou: [trans.] A very simple question. During the periodic burial of the mosaics, the only deterioration parameter included was the rain. Have you also considered air, sun? These are also deteriorative parameters. I have not heard them mentioned.

Margalit: I think everybody here agrees that reburial of a mosaic is the best way to protect it. The technical side is very complicated and it is not simple to rebury mosaics.

Piqué: I agree that for protection, the best way is reburial. But I think that every time we uncover something and the condition changes, that is the most drastic situation, and that is when causes of deterioration occur because we change the situation. So, I question the periodic reburial. And I also wonder why you want to expose the best mosaics? Because those are the ones that you are going to sacrifice in a way. I really like your idea of keeping most mosaics covered, but I wonder if we should just select the most representative mosaic and perhaps keep the really very important one underground.

Sivan: I feel that it is an original idea, maybe a good one, I don't know; but I am not sure that we can only speak of quantity versus quality. What do you mean by quality? Are we dealing with Rembrandts? Are we dealing with odd pieces? Sometimes a mosaic makes the site, as we say in this conference, and it is an integral part of the context. When we display a quantity of mosaics together, is the main effect to understand the people who lived in ancient times in such a building? I am not sure that quality is the only parameter we have to take into account.

Margalit: When I spoke about quality, I said that one mosaic can sometimes represent another. If, for example, there are mosaics with geometric designs, and you have ten rooms, you need only expose one, the best one. You can inform the public of the

existence of the other nine but only display the one which best represents the others. That is the idea.

Name unknown: Who is going to decide which is the best? It is a matter of individual taste. Just like the decision concerning the type of shelter to be built on a site.

Roby: When you were talking about periodic reburial you did not specify the amount of time in question. I am wondering whether you are talking about yearly, every five or ten years or every Sunday. How periodic? Also, on the subject of reburial techniques; I don't think that there is only one reburial technique. I think it depends on the situation, on the means and methods available. And I think we also need to adopt a flexible attitude towards burial techniques.

Ben Abed: [trans.] I think that the problem is much more complex than your presentation suggested. A villa is not a set of identical mosaics. Some mosaics belong to certain periods. And what we have to do is to show the entity and interpret this entity. If you decide to restrict the mosaics through the reburial of some of them, and I do not know what is the most representative mosaic, it is a bit simplistic; I think that the problem has to be viewed in its entirety. It should not be restricted to one given choice in favour of one given mosaic.

Margalit: I think that if we adopt a higher perspective and look at all sides, the way we look at a mosaic, then all those choices will become easier. We should look at the pattern of the ancient city, the environment of the city with the landscape around it, the romantic image of the city as painters did in the 19th century. I am afraid that we now blame the previous generation that used bad techniques and lifted mosaics; I am afraid that the next generation will blame us for filling all archaeological sites with modern structures. And we are losing the romantic image of archaeological ruins.

Corfield: The philosophies that you propose are the sort of philosophies that museum curators dealing with vulnerable materials have had to grapple with over the last few decades. The curator of a collection of watercolours has to decide that some of them will be displayed for a short period of time and then be replaced by others, and the originals put back into store. And you have this cyclical display of watercolours. Of course the difficulty there is if someone wants to have a look at the watercolour that is not on display, they can go and look at it in the store. Not quite so easy with your covered mosaic. But nonetheless, the decision about the length of time that the watercolour is displayed is based on the ability of the watercolour to withstand the light that shines on it. The same considerations perhaps could be calculated for the mosaic floors; how long can we safely leave them exposed before deterioration takes place without having extensive interventions to maintain them? Perhaps these are ideas that can be considered.

Nardi: I think that the technical problems will be solved. What you have done is to identify a certain direction which should be followed in future work. It is up to us to find the best applications to the requirement that you have shown. To use your words, we have to be aware that we are trying to conserve a mosaic, but we are destroying a site by building modern monuments on it. The strength of your argument is that it is not in opposition to the building of shelters, it is a powerful tool to cut the requirement for shelters. This does not mean that for a unique mosaic we will not decide to build a shelter. For the others we have to do something, and the direction that you have shown today is the direction of preventive conservation. Let us solve the problems and cut down the quantity of problems that remain. It is extremely interesting that this suggestion comes from an officer of the National Parks Authority of Israel, the body which is at the moment the main builder in the archaeological parks.

Palumbo: The fact that you have not been eaten alive by this audience means that what you have said actually hit the spot in a way. Archaeologists are digging too much; I am an archaeologist, so I am part of it. There are not enough money and resources to conserve what is being found. So, of course, reburial is the alternative. And, of course, serious consideration has to be given to what is to be exposed, so your direction is, I think, very important.

Margalit: Yes, but as I said, I am tired of hearing at every conference that we blame the archaeologist. Each conference says that they are digging too much. Everybody has said so. So, rather than blame the archaeologist, I have taken a look at our approach.

Barrow: I thought your presentation was excellent. We are thinking along the same lines, but I think it depends on having a very comprehensive management system at your site where there is a museum and interpretive programme, this kind of very comprehensive planning. Judging from many of the presentations that we have seen here there may only be an entrance station or in fact maybe nobody is at the site at all, and so perhaps this kind of thinking is not always applicable.

Margalit: I should say that this proposal represents a change in balance. Instead of direct intervention, I am speaking about a long period of treatment. We have just said about Paphos that there is a lot of dust. I am sure that in every public building here, there is one cleaner who cleans the floor every day. And I don't know why in Paphos there could not be one person who would come and clean all the mosaics on the site and take care of them every day. But they always think about huge programmes and huge plans.

Michaelides: I agree with you, but we want to clean the mosaics every day? That was my point. Every time we clean them...

Margalit: So why is there dust on them?

Georghiades: Perhaps it is a good idea to protect some of the mosaics and expose others. But I wonder whether it is a good idea to protect the second-class mosaics and expose the first-class works. After a while we are going to damage the best examples and we will end up with the poorer ones. Perhaps it would be better to expose the second-class mosaics.

Margalit: No, I am not speaking about this. Bearing in mind the three elements which I outlined, the first element emphasized quality rather than quantity. I said that you have to expose the best mosaics. So of course the best mosaics are also the unique and the most famous, quality being defined by many parameters. Unique mosaics will probably require some form of shelter. But I am referring to sites with many mosaics of different standards and in differing condition.

Hadjichristophi: [trans.] In the case of the Early Christian churches, how could we decide which part to show? We have to think in terms of a whole iconographic programme which has to be shown as an entity; it is not possible to hide one part and show another.

Neguer: [trans.] I have the feeling that Ze'ev (Margalit) is in need of support. He was not referring to sites with one or twenty mosaics, rather he was thinking of sites with five hundred mosaics with a surface area of 2,000 m^2 or 10,000 m^2. You cannot expose and maintain all of these mosaics at the same time because they will be destroyed by natural causes. Therefore you have to make a plan to expose all these mosaics in turn and show them to the public without running the risk of destroying them. This does not mean that you are going to provide roofing or shelters only for the unique mosaics. But it does mean that you have to design and plan properly for the covers and also take into consideration the interests of mass tourism, which is itself a destructive factor.

Kakoulli: The various shelters designed to protect mosaics have a function, most of the time successfully achieved, but in some cases they have not been so successful. But we have to consider that a mosaic is a part of a site, and although the shelter may not pose an aesthetic problem on the skyline, I think usually shelters do pose an aesthetic problem in the archaeological landscape. Instead of trying to find the perfect solution of sheltering, either temporary or permanent, perhaps we should concentrate on monitoring and long-term maintenance.

Bakirtzis: [trans.] The fifth session dedicated to shelters was of particular interest, as was obvious from the presentations and the following discussion. One could say that the title of this session in retrospect could have been: are shelters useful, and to what extent, in preserving and conserving mosaics *in situ*? If it is possible, after listening to all the discussions and presentations, I would like to reach the following conclusions, as general as possible. Firstly, shelters are, indeed, helpful in *in situ* conservation of mosaics; they do protect mosaics to some degree. However, they interfere

through their form in the picture of a historic and archaeological landscape. Secondly, shelters can be divided into three main categories: permanent, semi-permanent and temporary, the last of which has various subgroups useful for the classification and understanding of shelters. Thirdly, shelters are neither the first nor the easiest solution. There must come beforehand a study and analysis of the data, climatological, territorial, architectural, archaeological, and so forth, which, however, differ in every case. Therefore, it is not possible to formulate certain principles on the basis of which the construction of shelters as a whole can be based. Fourthly, it is useful to undertake to study and observe previous shelters constructed some decades ago in order to draw useful conclusions as to how mosaics behave under these shelters. Fifth, before employing the solution of a shelter, we must seek various alternative solutions which will postpone application of this measure, and the issue is selection, identification of these alternative solutions.

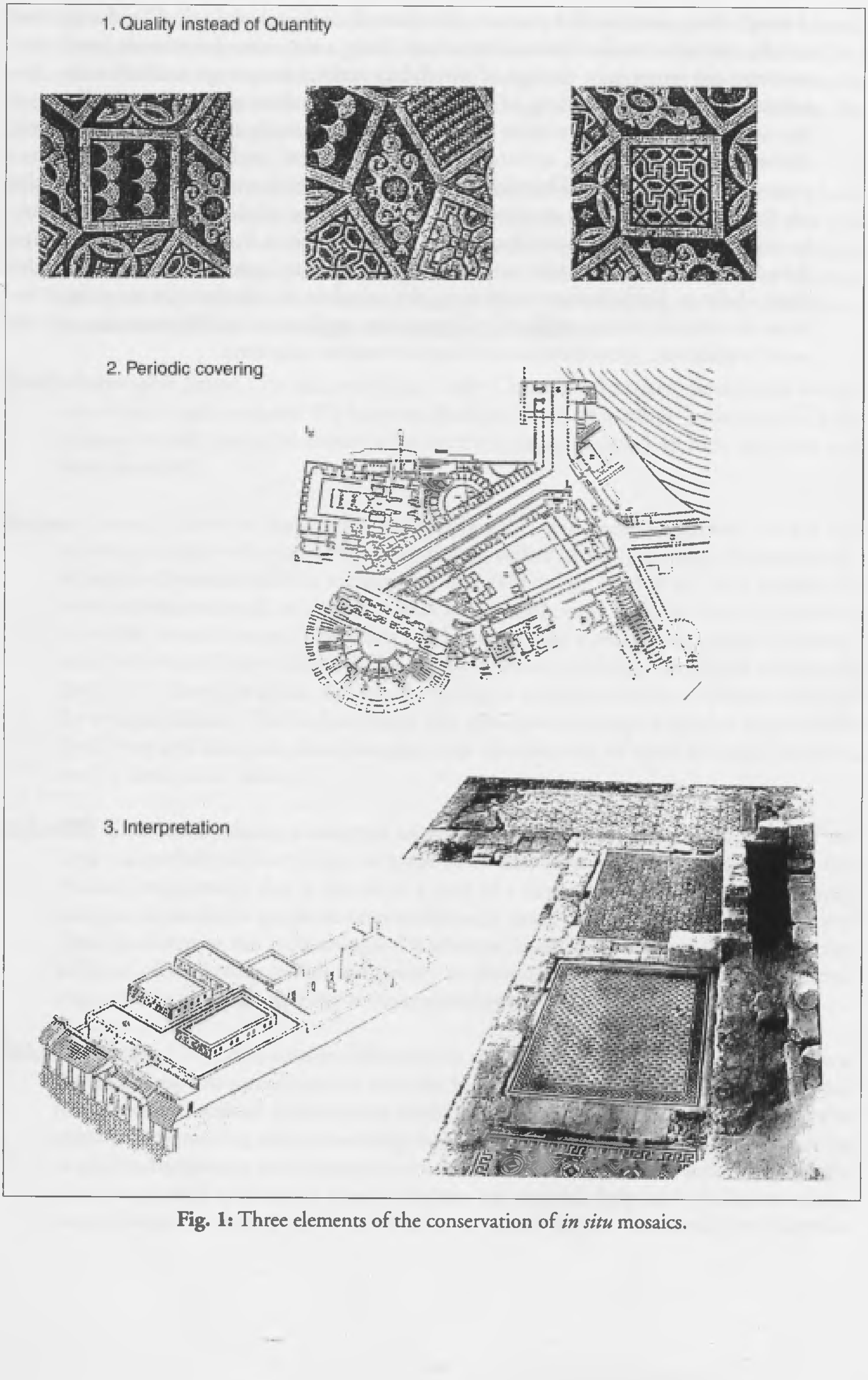


Fig. 1: Three elements of the conservation of *in situ* mosaics.

SESSION 6

THE PRESENTATION OF *IN SITU* MOSAICS

Demetrios Chryssopoulos

Aesthetic restoration and presentation of mosaics

Aesthetic restoration entails not only the continuation of conservation, but also the presentation of the historical significance of the work. The correct, and unaltered, presentation of a work of art enables the spectator, whether historian, archaeologist or future conservator, to obtain a complete picture of it.

Superior or inferior techniques are often mentioned in reviews, but this is rarely the case when superior or inferior aesthetic restoration is concerned. Thus, if a mosaic is presented incorrectly from the aesthetic point of view, although it may have been perfectly conserved technically, the entire historical and artistic value of the work may have been altered. Those viewing a work are interested in its overall meaning and significance rather than in the details of how and where the damage has been repaired.

The aesthetic restoration of lacunae in mosaics is purely a matter of ethics, with rules which are to be kept strictly. If an ancient object or a historical work such as a vase or sculpture has to be restored to its complete condition, this is done exclusively for reasons of its static support. This is not so in the case of a mosaic where particular attention must be paid to ensure that modern intervention remains visible. Nowadays, unfortunately, in my opinion, all kinds of completion have become purely a matter of personal conception and interpretation, thus leading to the observed wide variety of approach.

Correct aesthetic restoration should contribute considerably to the correct display of the work. It should not attempt to mislead the viewer and, most importantly, it should not alter its historical significance or encourage false conclusions.

In the light of these remarks we may cite first various methods which have been or which are generally applied, and secondly the methods which are internationally established and accepted as being most correct.

The following occasional attempts and improvisations of conservators and archaeologists may be listed, as well as the different methods of presentation and exposition of mosaics:

1. Incision of lines on the mortar of the lacunae according to the design of the mosaic.
2. Completion of the lacunae with tesserae.
3. Completion of the outline of the design that has been destroyed with a line of tesserae.

4. Painted representation of the tesserae in tempera.
5. Light overpainting, in tempera, of the imprint (*sinopia*) left by the detached tesserae on the mortar (for wall mosaics only).
6. Repositioning of the mosaic, retaining its irregular surface as discovered when excavated.
7. Completion of the lacunae with tesserae of a different colour from the original.
8. Completion of the lacunae with tesserae ca. 0.003 m higher than the surface of the mosaic.
9. As above but lower.
10. Enclosure of the lacunae filled with tesserae with a) lead strips, b) glass strips, c) marble strips and d) black or red tesserae.
11. Chipped material, in proportion to the tesserae, irregularly covering the mortar of the lacunae.
12. Sea pebbles, of approximately the same size as the tesserae, mixed with the mortar of the lacunae.
13. Overpainting, in tempera or aquarelle, of the "original design" of the mosaic on the fresh mortar of the lacuna.
14. Exhibition of the conserved mosaics on the walls of museums!
15. Painting in tempera or water colour (ochre) of the mortar of the lacunae in order to imitate areas of golden tesserae in all mosaics.

The following procedures have been presented and adopted by the Ephorates in Greece as being most ideal. Some of them (1, 2, 3, 5, 6, 7 and 9) are also employed by several archaeological services in Europe and North Africa:

1. Restraining of the borders of the lacunae with mortar ("crowing"), the width of which varies from about 0.01 to 0.02 m, according to the thickness of the substrata and the size of the tesserae while keeping the substratum visible (i.e. without covering the historical and technical elements) on wall mosaics as well as pavement mosaics.
2. Completion of the lacunae with mortar in pavement mosaics (to protect the substrata) to a level a little lower (0.003 m) than the surface of the tesserae.
3. Completion of minor lacunae in insignificant locations with ancient tesserae (not exceeding an area of 0.03 m^2).
4. Avoidance of completion of vital points such as human figures, animals, floral or geometric patterns.
5. Painted representation of the tesserae on the fresh mortar in tempera (for wall mosaics).
6. Slight repainting, in tempera, of the imprint (*sinopia*) left by the detached tesserae on the mortar, in their original colour (for wall mosaics).
7. Repositioning of the mosaic pavement by levelling its surface, eliminating any undulations which it had when excavated.

8. Completion of the lacunae of mosaic pavements with quarry sand mixed with brick powder (the quantity of brick powder proportionate to the colour of the ancient mortar), when the mosaics are exposed in museums or protected places with roofing.
9. Incision on the fresh mortar of the completion of geometric patterns.

As a credit to the Greek conservators, it may be mentioned that since the 1960s and until recently, they never completed the lacunae with any of the above methods but only with mortar or by restraining the borders of the lacunae. Since 1990, prior to proceeding with any aesthetic intervention, it has been necessary for the conservator in charge to submit a proposal to the Central Archaeological Council of the Ministry of Culture for their approval in each individual case.

DISCUSSION

Name unknown: I would like to hear more about wall mosaics, how they are dealt with, separately. And floor mosaics. I am a little bit confused with regard to aesthetic reproduction or an aesthetic way of dealing with these surfaces. I would like you to make the whole process clearer.

Chryssopoulos: There are thousands of different perceptions and ideas with regard to aesthetic presentation and restoration. We all know this because this is something we are frightened of, and we think it is too hot to touch, and I don't know why we have not touched it all these years. Nevertheless, I would like to say that with floor mosaics, as I showed, we have very different cases, as in wall mosaics. If we leave the historical elements, the statumen, visible to visitors, then we will have to take certain measures. We will have to spray the area so that plants do not start to grow. When we cannot do this we have to cover the whole of the damaged area with mortar, as I showed you. We also have another problem with regard to whether the mortar of the lost part will have to be slightly lower than the surface of the mosaic or at the same level as the surface. If the mosaic is in an open space and if the mortar is lower, water will accumulate. For wall mosaics I presented three cases from St. Sophia in Constantinople, and the Kariye Camii where, as you saw, there was a different way of looking at it because they were conserved at different times. Half of them were with cement, and the other half of the cases were bordered or banded around. Then there is the problem, if the damage at the centre of the mosaic is very extensive, what do we do? Do we close the gaps that aid deterioration or do we leave the masonry visible? This is something that has to be discussed because some people say that if we leave the deterioration and we leave the masonry showing, there will be a gap in the middle of the mosaic. Other people say that if we cover the damage with mortar, then we will have large surfaces covered with mortar. Here again, we ought to sit down and discuss this and decide what to do. As I said, it is complicated. Each of us has his or her own ideas and views with regard to aesthetic restora-

tion and presentation. I would say that when, for example, we have small losses of two or three tesserae at the centre of wall mosaics, then I don't think that there will be a problem if we leave them as they are. There is often a drawing underneath which shows what it was like. If, on the other hand, the destroyed surfaces are larger, up to twenty or thirty square centimetres, then we can place mortar there. I said I was not going to make any proposals, but I am making proposals. We could add mortar and draw or paint over it, and not just leave isolated holes or apertures in the middle.

Solar: If we could have a question more on ethics or philosophy of these aspects, it would probably be best, because the whole topic deserves a specific session and a keynote paper, and that cannot be covered now.

Menicou: With regard to deterioration, I would like to say that whatever we do to deal with deterioration should be done with documentation and with great sincerity. There are many options, and many variations in the methods used in the past.

Chryssopoulos: I would not like to criticize what was done in the past or why it was done. We respect what they tried to do. But we should not continue in the present situation. This is the problem, I think this is the most important thing, as far as I am concerned. We must all apply a standard policy. We have so many different cases that I showed you where we can adopt various methods without adhering to fixed rules. There are six or seven different cases in which I believe standard procedures could be adopted. This would obviate the need for much future experimentation and much talk about perfect technique and materials implemented, only to be followed, when we try to present the mosaic aesthetically, by our destroying everything that we have done. At some point we will come to standardize mosaic conservation and restoration, whether as a method to be implemented or as materials to be applied, or as a new technology. So much sand, so much lime, so much epoxy resin are still used in many countries. But the most important point is how to present the mosaic to the public.

Renée Sivan

Presenting mosaics to the public: an Israeli experience

The presentation of mosaics to the public is one of the most complex subjects in the field of presentation and interpretation of heritage. In addition to basic problems involving the conservation of the mosaics, including their vulnerability to the effects of nature and man, other far from simple interpretative issues must also be faced.

In addressing the question, we must consider two of its major aspects; firstly, exhibiting the mosaic *in situ*; secondly, displaying the mosaic in a museum or other exhibition hall.

In the second case, it is very unlikely that we will have to contend with the problem of protecting the mosaic from the ravages of nature and man. In such cases, the mosaic is already protected by the exhibition compound. The problem becomes a totally different one relating more to the character of the display and the aim of the exhibition. Once the mosaic is removed from its natural surroundings, it loses much of its intrinsic value and becomes more of an object, an isolated exhibit whose function is that of a document or work of art, rather than an integral part of the architectural context to which it belongs.

In a museum, in principle, we can move the mosaic and decide what is the most suitable place for display, taking into acccount, for example, the angles of lighting. We can also determine how people will move around the mosaic and so on. Even in terms of the interpretation, our freedom is much greater. The spaces that we are dealing with, since they are not an integral part of the building housing the mosaic, permit more diversity in interpretation.

When presenting a mosaic *in situ* the problem is much more complicated. A mosaic *in situ* is not an isolated object, but part of an architectural complex. As such it evokes a number of questions. Is the role of the shelter to reconstruct, even along general lines, the architectural structure which provided the original 'home' for the mosaic, or is it meant to fulfil a purely functional purpose? In other words is the shelter part of the presentation or only a protective device?

Whatever the concept of the shelter is, it very much affects the overall presentation of the mosaic, not only by its shape, which is by no means an unimportant factor, but also in the way it relates to the inner spaces of the original structure. That is why, when planning a shelter, it is important to consider the presentation concept.

The shape and form of the shelter are not the only issues which the presentation specialist has to be involved with. He has to deal with complex questions such as: how to expose the inner space or spaces without transforming them into a simple mosaic promenade, how to allow the visitors to appreciate the mosaic and at the same time to avoid congestion, how to convey to the public the story of the mosaic without creating visual obstructions which might clash with the mood we are trying to achieve. But his concern is not only with the physical problems of the presentation or merely to enable the visitor to appreciate the iconography and aesthetic values of the mosaic.

Apart from these, the visitor wants to know why the inhabitants or users of the compound or house chose this specific depiction? Are we looking at a 'carpet' which was the fashion of the period, or did the mosaic have a different meaning for the people of that time? Does it belong to a special historical context? How did the mosaic survive?

When presenting and interpreting a mosaic we have to deal with different levels of information, that together evoke the cultural significance of the mosaic and the site.

In order to examine the various aspects of the presentation and interpretation of mosaics and to answer some of the questions raised above, I would like to introduce two different approaches to presentation, both in the ancient city of Sepphoris (Zippori) in Lower Galilee [1].

DIONYSOS MOSAIC FLOOR [2]

In the summer of 1987, a mosaic floor decorated with mythological scenes depicting the life of the god Dionysos, was uncovered at Sepphoris. The floor was found in the triclinium of a Roman villa dating back to the first half of the 3rd century AD, and it remained virtually intact until the building collapsed in the 4th century.

The arrangement of the floor is typical of Roman period triclinia. The central part of the coloured mosaic is a large rectangle subdivided into 15 panels depicting the life of the Greek god Dionysos. Surrounding the Dionysos panels is an elaborate rectangular frame containing 22 medallions with hunting scenes and two busts of beautiful women. The medallions are formed by intertwining acanthus leaves. One long panel in the shape of the letter U, depicting a grand parade in honour of Dionysos, surrounds the southern end of the central rectangle and its frame of acanthus volutes [3].

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[1] For other papers on the conservation and presentation of mosaics from this site, see R. Albini and Ch. Zizola, as well as A. Costanzi Cobau and R. Nardi in this volume.

[2] The author of this paper was in charge of presentation and interpretation of the mosaic. D. Harel was responsible for the design and L. Belkin for the architecture of the pavilion. The site was developed by the National Parks Authority. The excavations at the site were conducted by the Joint Sepphoris Project of Duke University and the Hebrew University of Jerusalem, directed by Eric M. Meyers, Ehud Netzer and Carol L. Meyers.

[3] C.L. Meyers, E.M. Meyers, E. Netzer and Z. Weiss, "The Dionysos Mosaic", in R.M. Nagy *et al.* (eds), *Sepphoris in the Galilee: Crosscurrents of Culture*, Raleigh, N.C. 1996.

Once measures had been taken for the conservation and restoration of the mosaic, a permanent pavillion or shelter, inspired by the configuration of the architectural remains, was built to protect the mosaic and to allow the public to view it.

When planning the shelter it was clear that the focus of the visit would be the Dionysos mosaic. Other spaces in the villa, some of them also containing mosaics, were not emphasized, the main effort being to enhance the Dionysos mosaic. The new walls of the building were covered with velvet, and elevated walkways and a balcony were designed to facilitate the viewing of the mosaic.

So that the public can understand the structure and function of the site, an artistic reconstruction of the villa and the triclinium are on display at the entrance to the building. A series of transparencies provides an account of the process of discovery and the restoration of the mosaic. In the triclinium, our main concern was how to convey to the public the stories portrayed in the mosaic without creating visual obstructions. Each one of the scenes depicted in the mosaic is interpreted and presented in such a manner that the public, walking around it, can not only appreciate its aesthetic value but also understand the story portrayed.

The method of presenting the mosaic to the public is a unique example of its kind. To emphasize the fact that the triclinium and the Dionysos mosaic are not alone, and to attract the attention of the visitors to other rooms, we installed replicas of furniture belonging to the period in some of the rooms.

To supply the visitor with further information, there is a small site museum in the Citadel next door to the villa. Here, through interactive computerized programmes, visitors can find information about the site and subjects related to the mosaics, such as how the mosaics were made.

THE NILE FESTIVAL BUILDING [4]

In 1991, a large structure measuring 50 m x 35 m, probably a public building divided into a series of rooms, was uncovered at Sepphoris. The floors of this ancient building were all covered with mosaics, except for an area paved in stone that probably served as an open courtyard.

The mosaics on most of the floors consisted of simple geometric designs or floral patterns. Two of them depict Amazon scenes, another a centaur holding a dish with a Greek inscription: "Helpful God". At the entrance to one of the rooms a mosaic depicts two hunters. The largest (7.6 x 6.2 m), and the most beautiful, is a figurative mosaic with hunting scenes and celebrations related to the annual inundation of the Nile, which was thought to bring abundance to the world [5].

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[4] The Nile Festival Building was excavated by the Hebrew University expedition headed by Ehud Netzer and Zeev Weiss. The same team in charge of the presentation and interpretation of the Dionysos mosaic was responsible for the Nile Festival Building.

[5] Z. Weiss and E. Netzer, "The Hebrew University excavations at Sepphoris", *Qadmoniot* 30, 1997 (in Hebrew).

The presentation concept here was completely different from the Dionysos mosaic. The main idea was first of all to create a shelter that did not try to reconstruct the original building, but only to protect the many mosaics found on the site and to define the perimeter of the building. Secondly, the idea was to define the inner spaces of the compound and preserve the original circulation level so that the visitors would not feel that they were merely viewing a mosaic exhibit.

General information about the building itself and the process of conservation and restoration of the mosaics is presented to the public in the main hall of the building, the only space were the mosaic was not preserved.

The presentation and interpretation of the mosaics takes place in their original location. This is achieved primarily through graphic panels installed on the reconstructed walls in such a way that they do not interfere with the general environment.

These two sites at Sepphoris, the Dionysos mosaic and the Nile Festival Building, are examples of two unusual approaches to mosaic presentation, and they can serve as models for anyone facing the challenge of how to display such treasures.

DISCUSSION

Solar: We have now moved from the presentation of mosaics to the presentation of the context and the mosaic in its context. In your questions please remember that we are now concentrating on the presentation of mosaics rather than on shelters.

de Guichen: [trans.] I have very much appreciated your presentation and the variety of solutions you look for to present mosaics to the public. Sometimes you present the mosaic and you explain there is a work of art that exists, whether it is a mosaic or something else. And the second aspect is that you try to transmit a certain number of messages, aesthetic, historical, or possibly technical. As you stressed, you explain how a mosaic is actually made. It is very rare that people go to the third aspect which is the work, whatever it may be — and here we are talking about mosaics; the work is fragile, so you have its existence, then the message, and thirdly, its vulnerability or fragility. I don't know if we are able to do so. If you did, I would like to know what the public reaction was. Because if we are not able to get the message across that these works are very fragile, then we will not get all that much public support, or none at all. If we do not explain to the public that it is forbidden to walk on it, and if you do not tell them why, then they will walk on it. If we say it is fragile but we do not explain that walking on a mosaic causes great damage in a short period of time, then they will not understand. They do not understand why mosaics are fragile or how fragile they are, they do not understand how much money it takes to protect them. So this means we will not get the necessary support from decision makers and politicians. I would like to know whether you have done anything along those lines for this third aspect on fragility and whether the public has responded to this.

Sivan: [trans.] Personally, I think that the public is very intelligent. You should not underestimate them. Since the public is intelligent, I think sometimes it is enough to present the site properly, and the better it is presented, the more care people will take of it. In the case of Dionysos' villa, the fact that people circulate along walkways, bridges, floating bridges, they are so far removed from the mosaic that they realize it is something very special and fragile. And they look at it as though it is something rather far removed that does not belong to them. I think our heritage belongs to us all. In the case, for example, of the Nile House, the fact that people walk very close to the mosaic is very important. And there we have small protective bars which are almost invisible. The fact that we have a lot of interest in presenting the restoration and conservation process, the work that has been done in this building and in many others, too, I think this is a large part of my answer to you. We try to explain to the public that we conserve and restore because these objects are very fragile and we want to safeguard them for many generations to come.

Melucco Vaccaro: The main core of your presentation was the great differences between museum presentation and site presentation. I think that the public must immediately realize the differences, and that was so plainly and correctly shown by your report. Anyway, that is another evaluation that must be done. A site is something of some extent, a museum is something more or less that is for exceptional works out of their context. So, it is necessary perhaps to point out that broader intervention requiring less financial means is perhaps the only way to ensure the survival of larger archaeological sites.

Ben Abed: [trans.] I can see that since our last meeting, things have changed, and in the right direction. You know that I am very much in favour of very limited intervention *in situ.* I imagine your presentation of the site is pretty costly. I would like to know whether you do this for sites which receive a large number of visitors, in which case do all the tourists have the time to benefit from everything offered them, or do you select certain sites and only intervene on sites that are likely to have certain sectors of the public — for example, the more scholarly, erudite public, or young people?

Sivan: [trans.] I think both are true. There are some of each. There are sites that have far more visitors than this site, and for the time being we have not done anything about presentation. But there is also development of this site because of its aesthetic, cultural, and archaeological values. And we also cover various regions for touristic and economic reasons. We try to cover a large number of regions for this reason, so there is a lot of everything.

Solar: I would just like to add for clarification that this is one of the projects in Israel which is sponsored by the Ministry of Tourism. So, *a priori* there is a decision to invest a lot of money in this site plus a few other sites for the development and attraction of tourism, and that is why there is so much money. These interventions

are very expensive, but they are not made just because an archaeologist wanted to excavate or just because something beautiful was found there and has to be protected.

Eliades: [trans.] In your presentation, you showed us the method of lighting the mosaics. Could you tell me what factors you took into consideration so that the mosaics would be shown at their best? For example the angles of light, measures to bring out the colours, the quality of the lighting and such parameters.

Sivan: I cannot go into technical details because we are working with designers who deal with technical matters, light designers, setting designers and so on. But I will answer you in a different way. In the Dionysos mosaic, we use very simple lighting to emphasize the many depictions represented in this mosaic, and we create there a very artificial presentation. It is completely different from the way people in ancient times used to see these mosaics; the effect is very dramatic. In the Nile project, we decided not to use artificial lighting. We are only using the low level of light available under the shelter. We are not using artificial lighting, and I think that it is wrong to use artificial lighting on mosaics.

Stanley-Price: I liked your saying that we have to avoid giving the impression of a site with the mosaics as being a series of small swimming pools. And I thought the choice of the words swimming pools was particularly appropriate for the condition of some sites with mosaics. On a more serious note, I am delighted we have reached this stage of seeing the importance of presenting sites to the public, and I wondered whether in Israel you have experience of surveys of the public after they have been to such sites, to find out not whether they have simply enjoyed the visit but whether they have understood as much as you hoped they would about the history of the site, techniques, and so on.

Sivan: We did a survey at the Dionysos shelter, the presentation of Dionysos, and I think it is a very good example. People enjoyed it very much. Everybody who came out of the Dionysos presentation said that it was wonderful, it was the best thing that they had seen, it was so beautiful, it was perfect. And then I asked them about the villa, and they answered "which villa?".

de Guichen: [trans.] I would like to return to what I was saying. You said the public was very intelligent. And I have always thought they were intelligent. But we can stress certain things for them, and it is not obvious to the public that a monument is fragile. Very often you hear professionals saying that something has been preserved for five hundred thousand years and it will survive for another thousand years. We have to explain to the public that it is fragile. I will give you an example, the case of the Marcus Aurelius statue in Rome. It is a single bronze statue, the only one of the twenty four statues that remains. It was on the Capitol square which was restored, and for eight years the question was whether we were going to put it back in the

same place in the open air. And a survey of the visitors was carried out. They were asked what was the condition of the statue — in other words, if they thought it was in a poor state, they would support us technicians for the statue not to be placed in the open air. What happened? There were two very clear groups. They were asked their profession, and we asked them what their impression of the statue was. There were people who said the statue was in a piteous condition; the others said it was in magnificent condition. Those who said it was in terrible condition were plumbers, carpenters, bricklayers and masons, who knew about materials and looked at it and knew the bronze was terribly pitted. Who said that it was extraordinarily well preserved? They were politicians, barristers, doctors, all sorts of intellectuals, and university professors, of course. And they are the people who make the decisions, I am afraid. It was very interesting.

Sivan: [trans.] Yes, but all these intellectuals do not come to the sites.

de Guichen: [trans.] If they do not come to the sites, then have those who do come fill in questionnaires of that sort. And then you ought to be able to say that ninety-eight percent of the visitors find it is badly maintained and fragile, so give us more money.

Sivan: [trans.] No, I think Mr. Margalit can answer better than me. But from that standpoint, there are many sites where we give out questionnaires and we ask people how they find the site maintenance, if the presentation is good, etc.

statue placed in the open air. And a variety of these interviews carried out. They were asked what was the condition of the statue—in other words if they thought it was in a poor state, they would support us technicians for the statue not to be placed in the open air. What happened? There were two very clear groups. They were asked their profession and we asked them what their impression of the statue was. There were people who said the statue was in a parlous condition, it's frightful; it was in magnificent condition. Those who said it was in terrible condition were plumbers, carpenters, bricklayers, and masons who knew about materials and looked at it and knew the bronze was terribly pitted. Who said that it was extraordinarily well preserved? They were politicians, barristers, doctors, all sorts of intellectuals, and university professors, of course. And they are the people who make the decisions, I am afraid. It was very interesting.

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Sivan: [trans.] No, I think Mr. Marcelli can answer better than me. But from that standpoint, there are many sites where we give out questionnaires and we ask people how they find the site maintenance, if the presentation is good, etc.

Andreina Costanzi Cobau and Roberto Nardi

Conservation and protection of archaeological mosaics: the case of the Building of the Nile in Zippori

1. INTRODUCTION

This article describes the on-site conservation of a group of 12 polychrome floor mosaics found in a 3rd century AD public building in Zippori, Galilee [1]. The intervention is included in a broader project directed by the National Parks Authority of Israel. The part of the project regarding the mosaics was implemented in two different campaigns in 1994 and 1995 and is now concluded. Construction of fixed architectural roofing and sealing the trenches left from the removal of the original masonry walls is actually almost completed. Both campaigns were carried out in 'building yard' conditions and under temporary cover. The conservation of the mosaic of the Nile was carried out allowing the public to wach the work "live": a terrace was built for this purpose. We would like to describe the conservation intervention on the mosaics and comment on various aspects. Starting with technical procedures, we will then consider the principles and the objectives behind the choice of the methods followed and we will conclude with some general reflections.

2. DESCRIPTION OF THE BUILDING

The building is situated in the National Park of Zippori, in the Galilee, near Nazareth. Numerous excavation campaigns, as well as development plans, have rapidly increased the number of visitors (130.000 in 1994) attracted by the quality of the mosaics on exhibit. The building is called the Building of the Nile because the mosaic in the main room depicts Nilotic scenes (Figs 1, 2). Twelve of the many rooms in the building still have mosaic floor decorations. All are polychrome: some show equestrian figures, others have geometric designs. The mosaic of the Nile is unique, with scenes representing an extraordinary flood of the Nile, a Nilometer marking the level of the water, the town

[1] The building of the Nile has been excavated by Ze'ev Weiss from the Hebrew University of Jerusalem and published in H. Netzer and Z. Weiss, *Zippori*, Jerusalem 1994.

of Alexandria with the famous light-house, together with several scenes of wild animals hunting each other. They all share a high aesthetic and technical quality.

The mosaics' state of conservation divides them into two groups, according to whether or not original masonry is present. The masonry was stolen from part of the building in ancient times, causing severe damage to the floor foundations, considerable loss and upheaval to the mosaics themselves. Where the masonry (and the foundations) are still in place, the floors have some hollows in the bedding and surface calcareous deposits, but are in a generally good state of conservation. The damages caused by structural collapse are visible everywhere.

3. THE INTERVENTION FOR THE CONSERVATION OF THE MOSAICS

The intervention took place in two separate campaigns: April/June 1994 and May/August 1995. The first campaign was dedicated to the Nile mosaic; the second dealt with the remaining floors (Fig. 3). The work teams comprised eight professional conservators plus four local technicians. The division of the mosaics into two groups (one in the first and eleven in the second) depended upon the working and 'strategic' requirements of the site management: the work to be done on the "Nile", a very well known mosaic, was meant to create the conditions needed to authorize and finance intervention on the rest of the building. The apparently disproportionate time allotment (three months for one mosaic and four months for eleven mosaics) was due to the typology of the Nile mosaic (50 square meters of extremely fine mosaic work) and to its poor state of conservation (large hollow areas in the preparatory layers, insoluble surface deposits, areas where settling had crumbled the tesserae). This demanded considerable time, whereas during the second campaign, the different state of conservation of the mosaics and the greater familiarity of the conservators with the situation in general allowed a faster working pace. The working-steps, in the order of their execution, were: planning documentation; preventive measures of protection; pre-consolidation; in-depth consolidation; cleaning; surface consolidation; bordering; treatment of lacunae; final inspection; temporary protection; recommendations for final protection.

3.1 *The Plan*

The plan comprises one general section which describes the principle theories and methods of the programme (on-site conservation without detachment, use of traditional materials and techniques, admittance of the public, full documentation of the work as carried out and broad distribution of information). The second section analyses each floor individually. The diagram of the state of conservation, details of the work to be carried out, time estimates and costs are presented in this part. Using the plan, the "client" can make a financial and technical evaluation of the offer, can organize the contract documents and obtain the required authorizations from the Superintendent. From the technical point of view, the plan allows us to allocate resources, write up the work schedule, organize the purchase of materials and equipment (what was more convenient to buy locally and what had to be imported). Another, and in our opinion even more important

aspect of the plan, was its presence as a parameter for what was actually accomplished in the field. The comparative analysis of plan data and effective data, and particularly the study of errors in planning, furnished precious information to add to what we already have in this sector.

To do this, we drew up tables to be filled in daily, showing the date, floor number, technical operations, conservator's name, hours of work. The data thus collected became instrumental in drawing up new plans. They can be distributed and will enrich the files needed to plan the conservation and maintenance of archaeological sites.

Table 1. Data in this diagram refer to 12 floors, for a total of 250 m² of mosaic. Time is intended per m² and is presented in minutes (m) and hours (h). The state of conservation of the floors was very variable: from good to very poor, therefore the above data are interesting if taken as averages.

Floor	1	2	3	4	5	6	7	8	9	10	11	12*	**Average x square mt.**
Documentation	30m	5m	5m	5m	5m	20m	5m	10m	20m	40m	10m	45m	15 min.
Preventive m. preparation w.	90m	5m	5m	5m	30m	1h	30m	30m	1h	40m	20m	1h	30 min.
Consolidation	12h	10m	30m	10m	9h	12h	6h	3h	11h	2,5h	20m	2h	5 hours
Cleaning	7h	1h	20m	20m	2h	4h	3h	2h	3h	1,5h	1,5h	7h	2,5 hours
Surface consol.	1h	10m	10m	5m	15m	1h	15m	40m	20m	10m	30m	1h	30 min.
Bordering	2h	10m	5m	5m	2h	2h	2h	40m	20m	1h	20m	15m	50 min.
Lacunae treat.	2h	10m	10m	30m	20m	3h	3h	40m	1h	1,5h	20m	4h	1,5 hours
Final inspect.	12h	10m	5m	10m	50m	40m	10m	20m	1h	1,5h	2h	4h	2 hours
TOTAL	**38h**	**2h**	**1,5h**	**1,5h**	**15h**	**24h**	**15h**	**6,5h**	**18h**	**9,5h**	**5,5h**	**20h**	**13 hours**

3.2 *Documentation*

Documentation is the first operation carried out on-site: each mark on the mosaic's surface is classified and represented graphically on specific, pre-arranged drawings. The process starts by entering the state of conservation (type of decay) of the mosaic, details of the original techniques of making the mosaic (sinopia, *giornate*, retouchings), of the historic life of the building (uses, restorations, collapse). Documentation continues throughout the intervention, entering the operations carried out and the areas treated and will go on throughout maintenance[2].

[2] *Normal 1/88, Alterazioni macroscopiche dei materiali lapidei: lessico.* CNR ICR, Roma 1990.

Table 2. The list of the items observed during the documentation.

Carbonate deposits	Old walls
Decohesion of tesserae	Old restoration with tesserae
Deformations	Tesserae of glass paste
Detachments in depth	Bordering and fillings 1990
Detachment of tesserae	
Erosion of mortar between tesserae	Chemical cleaning
Exfoliation	Consolidation in depth
Fractures	Consolidation of glass paste
Lacunae	Extraction of soluble salts
Mechanical trauma	Filling and bordering
Pulverization of tesserae	Final revision
Scratches	Infiltration points
Subsidences	Lifting and relaying
	Mechanical cleaning
Engravure	Superficial consolidation
Sinopia	Velatura

In order to facilitate graphic representation, computer photographs were used as a base. During the first campaign, the information was entered directly at the site in order to perform fewer operations (and errors) and to obtain the finished product immediately. Nothing could have been more purely theoretical. The sunlight and the dust at the site made it difficult if not impossible to make the idea reality. Screened though it was, the sunlight made reading the monitor extremely difficult, leading to a lack of precision in entering data and to consequent stress for the workers. The dust quickly damaged the portable computer even though the keyboard was covered by transparent plastic. The second campaign saw us back to traditional paper and pencil, registering data to be entered later in the workshop. We feel it important to insist that documentation is not simply registration of data: it is first of all an instrument for the study and understanding of the mechanisms of decay, essential to the successful corrective measures (on structures and floors) to be carried out in preventive conservation.

3.3 *Preventive measures of protection and preparation of the worksite*

The concentration of delicate floors, their high level of fragility and the hollow spaces in the preparation layer of the Nile mosaic, allerted us to take preventive measures of protection.

The worksite was organized with marked paths; systems were set to supply electricity, running water, compressed air directly to the operators. On the Nile mosaic we built a structure holding two movable bridges in metal and wood panels, spanning the

width of the floor. They were held by a track based on the foundations of two opposite walls of the room. This allowed two different teams to work simultaneously on different areas of the mosaic without trampling directly on the tesserae. These bridges were easily moved when necessary, such as when tourists wished to view particular sections of the mosaic or the conservator's schedule permitted the total view of the floor.

This construction added one week to the planned work period, but it was created to ensure protection of the mosaic, the safe carrying out of the work and the correct development of subsequent activities.

3.4 *Preconsolidation*

During this operation, those areas of the mosaic in which tne tesserae have become loose or detached from their original beds are temporarily set. The borders of the floor mosaic are reinforced (exteriors and also the internal edges of lacunae) with lime-based mortar ($^1/_2$ Lafarge hydraulic lime, $^1/_2$ slaked lime, 2 sifted stone powder) set perpendicularly to the mosaic plane in a very thin layer (12 mm). The areas where the tesserae were detached and out of order and which needed consolidation and cleaning, were protected by gauze, once the areas were cleaned with varying kinds of dry and damp brushes. The gauze was applied with an acrilic resin, Paraloid B72, diluted in acetone 15%. Paraloid was chosen after direct comparison with PVA (Polyvinil acetate). This, while more practical because of lower toxicity, easier acquisition on the local market and greater elasticity of the finished product (with respect to Paraloid's great rigidness) turned out to be too vulnerable to the water that we would be using in a subsequent phase. The gauze was removed after consolidation using acetone compresses and brushing. In the rare instances of decohesion of the tesserae themselves, as for example with some vitreous pastes, a protective treatment was established using Ethilsilicate Waker OH, applied by brush or dropper.

3.5 *Deep Consolidation*

The main problem in dealing with deteriorated mosaic *in situ* is the loss of consistency and adhesion of one or more of the preparatory layers. This can happen at various levels from the deepest foundation layers to the very surface layers where the tesserae are set. Consolidation is carried out following these steps[3]:

3.5.1 *Location of hollows*

Done by hand, tapping the mosaic surface to hear the sound variation between "hollow" and "solid". The area identified as "hollow" is marked using mask-

[3] D. Ferragni, M. Forti, J. Malliet, J.M. Teutonico, G. Torraca, 'Injection grouting of mural paintings and mosaics', in *Adhesives and Consilidants*, IIC, London 1984, pp. 110-116. A. Costanzi Cobau, R. Nardi, 'In situ consolidation of mosaics with techniques based on the use of lime', in *ICCM Newsletter n. 5*, 1992, pp. 9-13. A. Costanzi Cobau, 'The Roman Forum. On-site conservation of floor surfaces during excavation', *Mosaicos no. 5. Conservacion in situ, Palencia 1990*, Roma 1990, pp. 127-138.

ing tape and is drawn on the relative graphic representation in the documentation.

3.5.2 *Creation of access points*

In order to work beneath the tesserae layer, it is necessary to create several access points depending upon the size of the area to consolidate, and the ease of linking these points. It is usually preferable to work in the lacunae or in damaged areas. Where this is impossible, several tesserae are removed, momentarily placed on a clay support, numbered, cleaned, and ready to be replaced.

3.5.3 *Protecting the areas to be lifted with gauze*

The hollows found near edges or lacunae are at times easier to reach from the edges of the lacunae themselves. This means that the mosaic must be previously 'set' with gauze in order to avoid sinking while the preparatory and consolidation work goes on. This is done as it was for "pre-consolidation."

3.5.4 *Removing all non-cohesive material (infiltrated earth, original disaggregated mortar) from the hollows*

The prepared holes provide access to the hollows; cleaning is first done using flexible steel instruments and an aspirator without water. After the initial dry cleaning, a water cleaning is carried out inserting small flexible metal tubes into the empty area. An aspirator is used to avoid accumulation of water and debris inside the hollows. When all the access holes are linked and the hollow has become one single even space, the procedure continues to consolidation.

3.5.5 *Introducing new mortar*

This operation is carried out with grouting mortar (Lafarge hydraulic lime, sifted pulverized brick dust 1:1 with water added to obtain a fluid mixture). The area to consolidate must be thoroughly wet. The infiltration is done with catheter syringes starting from one side of the hollow and working progressively towards the other. The process is slow and needs constant tapping up until the space is completely saturated (Fig. 4).

3.5.6 *Revision*

The consolidation can be perfected only during the few moments the mortar is liquid. It is therefore very important to check by hand and 'by ear' that the area being treated is completely saturated by the new consolidant. If not, more mixture is injected.

3.5.7 *Removing the protective gauze*

At least one day after consolidation (or more, depending on the climate), when the mortar has reached a degree of solidity, the gauze is removed.

3.5.8 *Closing access points*

When the infiltration is completed, the tesserae that were removed are replaced and the edges of the consolidated areas are stuccoed (where they reach the borders).

3.6 *Cleaning*

This was carried out preferably by using mechanical hand tools (scalpels, plastic brushes, small chisels), and pneumatic tools (micro-vibrators and nylon brush drills). Once the mechanical cleaning was done, and in order to touch up the results, paper-pulp compresses of AB57 (without sodium bicarbonate)[4] were applied for 4 hours. When the deposits were particularly resistent, the compress was applied more than once. Each AB57 application was followed by a distilled-water compress in order to lift away salt residues (Fig. 5).

3.7 *Surface consolidation*

This is a 'key' operation in the general economy of the result. A relatively simple and quick operation restores the mosaic to a consistency and wholeness of great visual and material impact. The tessellate surface is carefully prepared: the spaces between the tesserae are mechanically cleaned to the depth of the original mortar. An abundant layer of very fluid Lafarge hydraulic lime and pulverized stone dust (1 : 1) is applied by brushing and rubbing. This is left to dry for an hour, the excess is removed using dampened synthetic sponges. This renews the original mortar network among the tesserae, recreating the homogeneity of the surface that had been lost as the mortar decayed (Fig. 6).

3.8 *Borders*

These were defined by creating an edge at right angles to the mosaic surface 12 mm wide. The material used was a lime-based mortar made up of Lafarge hydraulic lime, slaked lime, sifted pulverized stone ($^1/_2 : ^1/_2 : 2$). The mortar was applied to a carefully wetted surface and then thoroughly polished.

3.9 *Treatment of the lacunae*

A double distinction was made in choosing the method to deal with the lacunae. These were treated with a lime mortar the same shade as the lightest tesserae, with the exception of very small lacunae (up to 20 tesserae). Where there was no risk or doubt of interpretation, the design was remade with tesserae; instead, if there were problems, the choice fell on using the mortar. The choice was conditioned by the need to restore form to the design, disturbed by many micro-lacunae. This facilitated the aesthetic enjoyment of the mosaic while maintaining its historic integrity in the presence of the larger lacunae.

The lacunae not reintegrated with tesserae required a double technique of foundation and finalayer mortars. The mortar for foundations, whose depth varied considerably,

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[4] L. Mora, P. Mora, 'Metodo per la rimozione di incrostazioni su pietre calcaree e dipinti murali', CNR, Rome 1972.

was used wherever a layer about 5 mm beneath the final floor level had to be created. This layer was made of slaked lime, non-sifted pulverized stone and washed residues of sifted brick dust in a ratio of $1:2:{}^{1}/_{2}$. At every 1 or 2 cm of mortar, a layer of washed ceramic fragments embedded in the mortar itself was used. The ceramic and the mortar's bigger granulometry (from 1-5 mm) acted as buffers as the mortar shrank during drying. The washed residues of sifted brick dust were used to add hydraulicity and hardness to the mortar without having to add Lafarge hydraulic lime (expensive and not easily found on the local market).

The final treatment of the lacunae consisted of a thin layer (less than 5 mm) of light coloured mortar similar to the white tesserae (Lafarge hydraulic lime, slaked lime, sifted pulverized stone in the ratio of ${}^{1}/_{2}:{}^{1}/_{2}:2$).

The surface was finished by repeated polishing for three days after the mortar was applied; the surface was smooth (no sponging) instead of rough matte which is aesthetically pleasing but dust-sensitive. The final surface of the lacunae was kept only 2 mm lower than the original to keep the two different materials separate (tesserae and mortar) without weakending the edges too much.

In one case, the floor picturing the Amazons, where the lacuna was greater in size than the remaining part of the original mosaic, a different surface finish was used. The final layer of mortar was tapped with a stone to create a dappled effect typical of the layer in which the tesserae are embedded.

This was done because the smooth finish, although neutral, assumes a definite 'personality' when it covers a large area, and would have interfered, in this situation, with the final, over-all reading of the mosaic. With this solution the lacuna becomes simply one of the preparatory layers of the floor without its tesserae. It was, obviously, the subject of lengthy discussions. The comments, put synthetically, are: negative because of the low dust resistence and close resemblance to the original foundation layer, but greatly positive for the aesthetic result and low interference with the mosaic design.

3.10 *Final Revision*

This gives the 'final touch' to the work: a careful revision of the entire mosaic surface, to replace occasional missing tesserae (1 or 2), to touch up the cleaning, patch up the stucco. This operation calls simultaneously for a detailed view and an overall impression. During this phase, the documentation is also checked and completed.

3.11 *Temporary protections*

The treatment of the mosaics has been implemented under temporary covers, to be dismantled and replaced with a stable roof after conservation.

To protect the floors during this work we left precise instructions to implement the following temporary protection:

- geotextile in direct contact with the mosaic;
- a 20 cm stratum of washed tuff grains.

The purpose of this cover was to produce a passive protection as a buffer against eventual mechanical stresses and accidental falls of objects. At the same time this protec-

tion was planned to be inert in case of rain (no substances added to the mosaic) and secure in preventing plants growing.

Unfortunately the protection was "improved" by applying plywood on top of the tuff. This, instead of offering extra protection, cut the ability of the grains to absorb mechanical stresses and produced rigid structures (dangerous for transmitting shocks to the surface of the floors). An even greater risk is the emission of chemical additives in case of rain, very common in winter time.

In the light of this experience and following the experiences carried out over the last years[5] on the temporary protection of mosaics, we now present a solution suggested for archaeological mosaics. This is made of "pillows" in geotextile, full of expanded clay (or washed tuff), sealed and reusable measuring: 200 x 150 cm and 100 x 150. Those pillows will be layed on a stratum of geotextile over the entire floor, directly applied on to the mosaic. The pillows will be moved and stored when the mosaic needs to be exposed and then re-laid onto the floor for further protection.

3.12 *Recommendations for the presentation of the mosaics to the public*

The mosaics of the Building of the Nile call for some preventive measures of protection before their opening to the public. The future conservation of the mosaics will be directly linked to the architectural solution adopted.

- They need to be roofed and protected from rain, wind-swept rain and floods;
- Visitors can be allowed to cross the corridors between the mosaics (where there is no mosaic on the floor) but solid protective measures must be taken to prevent intrusions. Paths or bridges must be set to protect the mosaics from being trampled on;
- A barrier (even a textile wall) must be built to limit dust entering the area of the polychrome mosaics;

3.12.1 *Trampling*

The surface of the mosaic must be protected from the mechanical stresses linked to the passing of visitors. The treated mosaic is now capable of supporting one operator employed to execute the maintenance programme, but is not physically capable of supporting the stress created by visitors. Peripheral paths or bridges could be created or a structure that permits observing the mosaic but avoids the direct contact between the visitors and the mosaic.

3.12.2 *Direct exposure to sun*

The powerful heat of the sun may cause at least three types of damage: thermal expansion, salt migration/crystallization, growth of micro-organisms

[5] A. Costanzi Cobau, 1990, pp. 127-138.

(this last point will be treated separately). To avoid the aforementioned risks it will be necessary for the roofing to protect the mosaic from direct sunlight. The covering will be efficient if it separates the mosaic from direct contact with the sun's rays.

3.12.3 *Direct rainfall and wind-swept rain*

It is important to avoid contact between water and the mosaic. Water is specified as that which comes from direct rainfall, rain carried by wind, or flooding (the latter point will be dealt with separately). To the potential damage from solubilizing and instigating movement of the soluble salts is added the mechanical damage caused by the impact of direct rain drops.
The architectural structure must be constructed with these elements in mind and protect the mosaic from the top (direct rainfall), from the sides (rain carried by wind), and flooding (gutter system).

3.12.4 *Flooding*

In addition to the aforementioned risks, the risk of flooding must be mentioned. Such an event would bring a large quantity of debris (mud, various clays) that would seriously compromise the cleaning of the mosaic. One must therefore foresee the presence of structures (peripheral drainage) capable of collecting and draining excess water.

3.12.5 *Underground water*

This is defined by the passage of great quantities of water that may be linked to the presence of disused ancient channels. This would produce leakage of water and eventual erosion of the foundations and the introduction of an anomalous quantity of humidity. This risk could be avoided through an archeological analysis of the adjacent area and re-routing and maintenance of eventual channels.

3.12.6 *Biodeterioration*

The growth of micro-organisms is among the factors most linked to the architectural choices. The most efficient protection will be the constant maintenance of the floors.

3.12.7 *Dust*

It is probably one of the most urgent and macroscopic problems of the mosaics. This is obviously related to its setting in a rural environment. To avoid dust deposits on the mosaic turning into an insoluble crust, one must implement a continuous and frequent maintenance programme. It is suggested that this factor is kept in mind when designing the architectural structure and to foresee problems relating to an enviroment which is semi or com-

pletely protected from the infiltration of dust. This does not necessarily lead to heavy, solid structures. The dust may be screened even by light and flexible materials (textiles).

3.12.8 *Unplanned artificial humidification*

This signifies the risk that one, in order to revive the colours, throws water on the mosaic. It is well known that this is practiced (frequently internationally and locally). One must foresee the possibility of preventing the risk by informing the tourist guides and, at the same time, by controlling the area.

4. PRINCIPLES AND OBJECTIVES GUIDING METHOD CHOICES

The plan for on-site conservation of a building with 12 mosaic floors, carried out in an archaeological area open to the public, is more complex than straightforward conservation might be. Without in any way diminishing its strictly conservation specific aspect, we would like to indicate other components of the intervention: the degree to which careful administration of a conservation programme can contribute, in terms of technical, cultural and training initiatives (project cultural quality). We feel it is interesting to stress these aspects because, in spite of the importance that they normally have in the general budgetting of this work, there is a tendency, in professional literature, to overlook this in favour of more strictly technical details, such as the choice of materials and restoration techniques. This is the result of the old viewpoint that considers restoration as the qualifying (and at times unique) moment of the conservation process, rather than as a technical phase of a broader, more complex plan. Given this, we can see which additional objectives (besides, that is, the material result of the conservation of the mosaics) were attempted at Zippori. These are: to demonstrate the validity of the principle of *in situ* conservation; to maintain all the historical values visible on the mosaic surface; to open the work site to the public; to guarantee a maintenance plan by training local staff.

4.1 *To demonstrate with practical results the validity of the principle of* in situ *conservation of mosaics without detaching them and using exclusively traditional materials and techniques*

Few years have passed since ICCM (International Committee for the Conservation of Mosaics) [6] fostered discussion regarding the steps to be taken in *in situ* consolidation of mosaics versus automatic detachment, and in favour of the use of traditional materials and techniques, as opposed to cement and synthetic resins. So few, in fact, that it is surprising to see how much progress has been made. We can start no earlier than the middle of the 80s to find the beginning of the process which has led, today, to the almost complete acceptance of the principle of mantaining mosaics and wall paintings *in situ.*

[6] G. de Guichen, 'A short history of the Committee', in *ICCM Newsletter n. 5*, 1992, pp. 4-5.

The conservation of the Nile mosaic was strong propaganda in this sense: if the method was successful with such an important mosaic, then it must work.

As we usually do, we invited, using a multilanguage questionnaire, public comment on certain aspects we felt were important or perhaps dubious. At the question: "*To conserve and to exibit to the public the mosaic of the Nile we had 2 possibilities*": people answered in the following way: 89% "*to restore the mosaic* in situ *and to construct a cover for protection*" and 11% "*to detach the mosaic and to transfer it to a museum*".

4.2 *To maintain all the historical values visible on the mosaic surface and otherwise classified as: reutililization, old restorations, settling, mechanical damage, lacunae, breakage*

Directly connected to the *in situ* conservation of the mosaic is the theme of preserving the aesthetic image of the floor as it has come to be through the centuries. Obviously we do not mean dirt deposits or other extraneous elements that interfere; we mean the preservation of all natural and anthropic traces which have characterized the mosaic as we know it. In order to understand the principle more clearly, we can use as examples a modern mosaic and an archaeological mosaic. The place we would expect to find the former is probably an interior design show; whereas the latter would be an archaeological excavation. We must respect and satisfy the expectations of the public that comes to visit a site, avoiding the trap of presenting a mosaic "bright, shiny, good as new." We should, instead, encourage an historical interpretation through the marks left in time, presenting a clean work of art, free of disturbing elements but complete in its particular history and within its own context. Asking the visitors: "The mosaic as you see it today conserves the signs of its history such as the Byzantine restorations and the indentation caused by the fall of the ceiling", 77% think that "this is part of the history and therefore must be conserved and presented to the public" and 23% think that: "these elements disturb the legibility of the mosaic and must be removed in order to bring the surface to its original level state".

4.3 *To open the work site to the public and thus transform a technical intervention into a cultural event*

Thanks to the terrace built above the Nile mosaic, almost 10,000 visitors each month were able to see work in progress 'live' (Fig. 7). This initiative was supplemented with information posters, updating briefings for tourist guides, lectures and guided tours. All this contributed to open the technical intervention into a cultural event, creating greater sensitivity among the public towards safeguarding the cultural heritage. Opening the conservation project to visitors does not means simply to allow the public physical access to the site: the relationship with the public must be active, it must be managed rather than endured. The public must be made to feel welcome by didactic aids or guided tours. In Zippori the tourist guides were constantly brought up to date on the progress of the work, and thus they functioned as a cushion between the public and the conservators. The response of the children has been very positive, as has been shown by the large number of guided tours requested by the schools. The initiative met with great public success and achieved considerable media attention.

4.4 *To guarantee a maintenance plan by training local staff*

Conservation does not end with the intervention itself but must continue through the years with constant maintenance. We must say that a conservation programme's success is measurable by the future maintenance of today's results. It is equally clear that the best way to ensure that maintenance will continue is to make it financially viable. This means minimal present costs, maximum future saving. To achieve this the resources found in the field must be used and maintenance must be immediately linked to the conservation intervention (obviating damages and limiting future restoration needs). The conservation team from Rome was therefore reinforced by four local staff workers. They were trained to carry out maintenance operations such as documentation, cleaning and possibly revising the stucco work and consolidation.

The mosaic floors are consolidated, cleaned, filled and ready to be presented to the public. The recommandations for maintenance presented below refer to the day the mosaics will be re-opened on display, inside an architectural structure or roof.

Maintenance will be organized in two different parallel phases: direct treatment of the mosaic and control.

Direct treatment:

- dry cleaning of the mosaics with plastic soft brushes and vacuum cleaner;
- light humid cleaning with sponges;
- control of the solidity of the mortar in between the tesserae and replacement of consolidant where required (see: superficial consolidation)

Control (recording data):

- of growing of micro-organisms and plants
- of crystallization of soluble salts
- of the hollow spaces in the preparation layers.

These operations will be carried out by two local operators. It is suggested that the same technicians that made the conservation work (CCA) will carry out a general review of the mosaics (*una tantum*) in the first 5 years after the treatment.

Operations:	***Schedule:***	***Time***	***Time x month***	***Time x year:***
dry cleaning	once a week	1 day	4 days	52 days
humid cleaning	once every two weeks	1 day	2 days	26 days
control of the mortar	once a month	1 day	1 day	12 days
general control	once every three month	2 days		8 days
dry and humid cleaning	special climatic or social events		5 days	
		TOTAL	**x year**	**103 days**

5. CONTINGENCIES

This item always appears in the balance of payments, but never in reports. The reason probably is that the conservator is afraid of being accused of something going wrong. We would instead like to comment upon an unplanned aspect of the programme since analyzing contingencies is the best way to avoid similar errors in the future.

A series of organizational problems led to undertaking the second campaign while the cover and new wall foundations were being built. This created a series of obstacles that need no comment:

- the floors were not filled up to the outside edges;
- people not connected to the conservation project were continually moving around consequently damaging the mosaics;
- the conservators were constantly distracted by so much extra activity;
- the newly restored floors had to be covered again with geo-textile and washed tuff grains for their protection;
- organizing an official opening ceremony for public and media at the end of the job was impossible.

6. CONCLUSIONS

It has again become evident that during a conservation process the mosaic is the weakest element in the building and must be given absolute priority in terms of protection. This means that excellent working conditions must always be created, limiting interference and the number of operations to be carried out. Every contact with the mosaic (documentation, photos, visits, interviews, studies) is a source of potential damage in spite of who may be responsible. Ironically, the more the person in charge feels part of the process and expert in it, the more careless and possibly dangerous, he becomes. And even if these damages, should they occur, be minor, their very number creates a problem. The protective measures (temporary earth covering, covers of other kinds) are in any case stress sources for the floor, straining one tessera against another. This allows us to define a new threat: Excess Care.

The obvious conclusion: efforts must be concentrated on planning, even putting off the starting date to ensure excellent working conditions.

At the end of this experience, we reaffirm the validity of the principles and techniques such as: *in situ* conservation without detachment, preservation of historic 'traces', techniques based on the use of traditional materials; and especially we would emphasize the success we met in opening the work-site to the public. Visitors (and the media) responded enthusiastically, confirming the concept that investments in information have high yielding results.

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DISCUSSION

Solar: Seeing the public watching conservators, and having been several times among the public, makes us think, in the Getty Conservation Institute, concerning the wall painting project that we have, that we should never finish the project. It is much more attractive for the public to see conservators at work than to see the completed work. And it is the same with archaeological sites: it is much more attractive to see archaeologists working, than a nice, beautifully presented archaeological site.

Costanzi Cobau: I hope so.

Chantriaux-Vicard: My question concerns surface consolidation, pointing on the mosaic; the question is whether it is a general step on the whole surface of the tesserae, if it is systematic for any mosaic preserved *in situ.* It is harmless because it is done with lime mortar grouting, so it is compatible with ancient materials. But visually and historically, you intervene in a way which means something because you are bringing something new; you erase places that have changed. The joints are eroded. It would be better to consolidate existing joints rather than rejoining completely.

Costanzi Cobau: The surface consolidation is very important. You have to see it from the opposite point of view. If you do not do that, you leave the tesserae with a lot of space where nothing could grow, and this kind of consolidation is very like surface consolidation. Just close the gaps. It is like a sacrificial layer — in probably three years you will have to repeat the operation.

Menicou: [trans.] We are not talking about technical details. When we talk about the gaps between the tesserae, whether they are full or empty, this is not a technical matter; nor is it a matter of aesthetics. It concerns the tesserae themselves and the mosaic iteself. If, for example, people walking on the surface have deposited foreign matter during the year in the spaces, this has to be removed, and we have to take care not to add new foreign matter when we undertake conservation work.

Piqué: I would like to know if you do reintegration of the losses. I always see very nice neutral tones, so I wondered if you ever do something.

Costanzi Cobau: Yes. Where there is no risk, in the case of small lacunae, we think that it is better to fill them with tesserae.

Piqué: But your infill is always in a neutral tone?

Costanzi Cobau: Yes, always in a neutral tone.



Fig. 1: Mosaic of the Nile. General view.



Fig. 2: Mosaic of the Nile. Detail.



Fig. 3: General view during work in progress.



Fig. 4: Deep consolidation. This operation is carried out with grouting mortar. The infiltration is done with catheter syringes starting from one side of the hollow and working progressively towards the other. The process is slow and needs constant tapping up until the space is completely saturated.



Fig. 5: Cleaning. This was carried out preferably by using mechanical hand tools and pneumatic tools, followed by application of paper-pulp compresses of AB57. Each application was followed by a distilled-water compress in order to lift away salt residues.



Fig. 6: Surface consolidation. The tessellate surface is carefully prepared: the spaces between the tesserae are mechanically cleaned to the depth of the original mortar. An abundant layer of very fluid Lafarge hydraulic lime and pulverized stone dust (1:1) is applied by brushing and rubbing. This is left to dry for an hour, the excess is removed using dampened synthetic sponges. This renews the original mortar network among the tesserae, recreating the homogeneity of the surface that had been lost as the mortar decayed.



Fig. 7: Thanks to a terrace built above the Nile mosaic, almost 10,000 visitors each month were able to see work in progress 'live'. All this contributed to open the technical intervention into a cultural event, creating greater sensitivity among the public towards safeguarding the cultural heritage.

Eftychia Kourkoutidou-Nikolaïdou

La restauration des mosaïques murales dans les monuments de Thessalonique

La mosaïque murale constitue l'expression la plus brillante et la plus luxueuse de la peinture byzantine dans la décoration d'églises, de palais, de mausolées et d'autres édifices somptueux. Nécessitant une technique difficile et coûteuse, la mosaïque murale est le fruit d'un épanouissement artistique et d'une aisance financière. C'est pour cette raison que les meilleurs exemples de mosaïques murales apparaissent dans des périodes de prospérité qu'exprime la magnificence de ce type de mosaïques.

De l'époque paléochrétienne, trois grands centres régionaux témoignent, à travers les ensembles de mosaïques murales conservées, de la présence d'ateliers locaux de production autonome de mosaïques, d'une haute qualité artistique, et révèlent les liens et les influences avec l'art impérial de Constantinople [1]. Ces centres sont Rome et Ravenne en Italie et Thessalonique en Grèce. A Ravenne, les mosaïques de trois monuments réalisées par des artisans byzantins (le mausolée de Galla Placidia, Saint-Apollinaire-Le-Neuf et Saint-Vital), se distinguent non seulement par leur haute qualité et un style très fin mais aussi par leur technique de fabrication et les matériaux utilisés [2].

Thessalonique fut un grand centre de production de mosaïques murales durant l'empire byzantin [3]. Ses monuments conservent des ensembles de mosaïques qui reflètent une haute spiritualité et une rare sensibilité artistique. La relation interne de ces mosaïques avec l'art de la capitale apparaît non seulement dans le cours parallèle suivi par les mosaïques murales comme moyen d'expression artistique mais aussi dans leur technique commune. Un élément caractéristique de cette technique est l'usage raffiné de petites tesselles en pierre naturelle pour le modelé du visage et sur les parties dénudées du corps. La grande variété chromatique des tesselles en verre témoigne en outre d'une importante production de pâte de verre. Des fragments de mosaïques murales trouvés lors de fouilles

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[1] Le mot d'atelier recouvre soit des groupes ou des équipes de techniciens qui travaillaient dans leur ville et dans des quartiers mais a aussi le sens d'école. Voir P. Assimakopoulou-Atzaka, *Σύνταγμα των Παλαιοχριστιανικών Ψηφιδωτών της Ελλαδος*, Vol. II, Salonica 1987, 7 art. 4.

[2] Per Jonas Nordhagen, "The Penetration of Byzantine Mosaic Technique into Italy in the Sixth Century AD", *III Colloquio internazionale sul mosaico antico, Ravenna 1980*, Ravenna 1984, pp. 73-84.

[3] E. Kourkoutidou-Nikolaïdou, "Early Christian Wall-Mosaics in Macedonia", *Actes du 3ème congrès international des études macédoniennes*, Melbourne 1995, à paraître.

dans d'autres grandes villes paléochrétiennes de Macédoine, telles que Philippes et Amphipolis peuvent à notre avis être rattachés à un atelier de Thessalonique.

Au cours des quarante cinq dernières années, le soin porté par le Service archéologique grec aux monuments de Thessalonique s'appliquait à des travaux de restauration, de consolidation, de nettoyage et de finition esthétique des mosaïques murales. Les tremblements de terre qui frappèrent durement la ville et ses monuments en 1978, touchèrent également les mosaïques. Deux des ensembles de mosaïques parmi les plus importants au monde, les mosaïques de la Rotonde et la mosaïque de l'Ascension dans la coupole de Sainte-Sophie subirent d'importants dommages. Dans la Rotonde, d'anciennes fissures s'élargirent et les mortiers de support de la mosaïque se détachèrent de l'appareil des murs. A Sainte-Sophie, la mosaïque de la coupole présentait un important décollement de l'appareil des murs. Pour appréhender l'étendue du problème, il fallut prendre en compte les éléments du support de ces mosaïques et la technique adoptée pour la pose des tesselles, comme le révéla l'étude entreprise avant les travaux de restauration [4]. La pose des tesselles se faisait directement sur le mur, sur une surface de mortier spécialement préparée. Cette surface se composait de trois couches successives de mortier dont les deux premières contenaient, à un degré différent, de la poudre de brique, des petits morceaux de paille, de roseau, de bois, du sable et des petits caillous, tandis que la troisième couche, au grain plus fin, renfermait de la paille finement hachée. Pour assurer une plus grande stabilité, les couches de mortier étaient fixées à l'appareil des murs à l'aide de grands clous en fer. Sur la dernière couche de mortier, on dessinait souvent une esquisse de la représentation en monochrome (sinopia) brun ou noir, qui servait de guide au mosaïste. Les tesselles étaient ensuite posées sur le mortier frais.

Après les premières interventions de sauvetage, trois programmes de restauration des mosaïques murales les plus endommagées furent élaborés.

1^er^ PROGRAMME (LA ROTONDE)

Il concernait les mosaïques des trois grandes voûtes dans les niches ouest, sud et sud-est de la Rotonde. La voûte de la niche ouest est recouverte d'une mosaïque ornementale polychrome sur un fond d'or qui rappelle un tissu précieux, jeté comme un tapis sur la surface du plafond voûté. La voûte de la niche sud-est est couverte d'un treillis de bandeaux et de cercles entrecroisés formant des octogones dans lesquels s'inscrivent en alternance des oiseaux et des fruits. Dans la niche sud qui correspond à l'entrée sud, domine par son symbolisme religieux, sur fond d'argent, une grande croix encadrée d'étoiles, d'oiseaux, de fleurs et de fruits [5].

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[4] En ce qui concerne la restauration des mosaïques de Thessalonique après les tremblements de terre de 1978, voir les rapports de l'Ephorie des Antiquités byzantines de Thessalonique dans "Χρονικά του Αρχαιολογικού Δελτίου" à partir de 1978. Voir également E. Kourkoutidou-Nikolaïdou, *Τα ψηφιδωτά της Θεσσαλονίκης και ο Ιωάννης Κολέφας. 'Ενα χρονικό της συντήρησης των ψηφιδωτών της Θεσσαλονίκης μετά τους σεισμούς του 1978* (tome consacré à Iannis Koléfas), 1990, pp. 32-51.

[5] Voir la description analytique des mosaïques de la Rotonde et le choix d'une bibliographie antérieure dans J.M. Spieser, *Thessalonique et ses monuments du IV^e^ au VI^e^ siècle*, 1984, pp. 125-164.

Ces mosaïques, de même que l'appareil des murs, présentaient d'importantes fissurations dangereuses. La nécessité d'une intervention sur l'appareil des murs avec des injections était immédiate. Pour éviter une aggravation des dommages de la mosaïque que les matériaux injectés pouvaient provoquer, on décida de déposer les mosaïques des trois voûtes et de les remettre en place après les travaux de consolidation de l'appareil des murs. Ce programme, comprenant différentes phases, débuta en 1979 et fut achevé en 1983 sous la direction du professeur de l'École des Beaux-Arts, G. Koléfas.

a) Phase de préparation. Repérages topographiques, relevés par dessins et par photographies, dessin *a tempera* des joints de découpe des panneaux et entoilage de la surface de la mosaïque. L'entoilage consistait à encoller trois tissus superposés (gaze chirurgicale, calicot et toile de jute) recouverts d'un papier épais. Pour l'encollage de la gaze, on utilisa de la nitrocellulose. Après l'encollage du premier tissu, on retira les tesselles des joints de découpe qui furent collées sur un papier et conservées dans une boîte spéciale. Sur chaque tissu et sur la dernière couverture en papier, furent notées toutes les mesures et les éléments des coordonnées, indispensables à la remise en place exacte des mosaïques.

b) Phase de dépose. Après avoir libéré les joints de découpe de l'appareil et du mortier de support, on entrepris la dépose proprement dite de la fresque de l'appareil des murs. 264 panneaux de 0,50 x 0,70 furent en tout découpés. La dépose dura 4 à 5 mois pour chaque niche.

c) Phase de traitement. Après leur dépose, les panneaux de mosaïques furent placés à l'envers dans des coffrages en bois spécialement fabriqués qui adoptaient la même courbe que la voûte. Ces coffrages furent entreposés à l'intérieur du monument dans une construction en verre afin de garantir des conditions de température et d'humidité, contrôlées et connaissant de très faibles variations. Il faut noter ici que l'humidité à l'intérieur du monument variait de 85 à 90%. C'est dans cet espace que fut traité le revers des mosaïques. Les trois couches du mortier de support furent retirées, suivi d'un nettoyage minutieux des joints. Le premier nettoyage des mortiers fut effectué avec une alène. Le second, travail minutieux et spécialisé s'effectua au moyen d'une roulette de dentiste afin d'approfondir les joints entre les tesselles. Par la suite, le contrôle des tesselles révéla la nécessité d'une consolidation. Chaque panneau exigea entre 8 et 10 jours de travail.

d) Phase de remise en place. Après la consolidation de l'appareil des murs des trois niches, débuta la remise en place des mosaïques, précédée d'un nettoyage des murs, de la détermination des points de mesure et de la pose d'un nouveau mortier de support dont la composition fut déterminée après une analyse en laboratoire d'échantillons des trois couches du mortier d'origine. Pour retenir le mortier, on fabriqua des clous en titane pour remplacer les clous d'origine en fer qui s'étaient oxydés. Les tesselles des lignes de découpe furent

ensuite reposées, le faîte des voûtes et les lignes de fissures reçurent un nouveau mortier de couronnement et la surface des mosaïques fut nettoyée. Dans la voûte sud, une autre intervention fut nécessaire sur les tesselles en argent. Il fallut recoller la fine membrane de pâte de verre qui retenait la feuille d'argent et qui se détachait sur de nombreuses tesselles.

La finition esthétique fut reportée afin de présenter un aspect unifié dans l'ensemble du monument.

2e PROGRAMME (LA ROTONDE)

La coupole de la Rotonde est couverte de mosaïques datées du 5e siècle, uniques, non seulement en raison de leur haute spiritualité mais aussi pour leur expression artistique. Elles se développent sur trois registres dont celui du milieu a disparu aujourd'hui. Au sommet de la calotte de la coupole, le Christ était représenté en majesté, comme le révèle l'esquisse conservée sur l'appareil des murs. Il était entouré d'une couronne tressée de fruits et de fleurs tenue par quatre anges. Entre ces derniers se dressait le Phénix, oiseau mythique, symbole de l'immortalité et de l'éternité. Dans le troisième registre, se déroule la frise des martyrs devant diverses constructions fantastiques avec des autels, de luxueuses tentures et des balustrades qui représentent symboliquement l'Église céleste. L'artiste, en essayant de rendre la physionomie particulière et le monde intérieur de chaque martyr a créé tantôt des portraits à la beauté et à l'harmonie classique, tantôt des figures exprimant une profonde spiritualité et une quête intérieure.

Ces mosaïques présentaient un décollage de l'appareil des murs, plus ou moins grand par endroits. Pour les consolider, nous avons adopté un processus de restauration sur place en suivant les phases suivantes:

a) Phase d'entoilage. La mosaïque a été entoilée avec de la gaze chirurgicale en bandes horizontales et verticales pour la protéger de la pression et des vibrations que provoquent les injections dans la partie extérieure de l'appareil des murs de la coupole.
b) Phase d'imprégnation, qui est un travail particulièrement minutieux de la restauration. Des imprégnations à l'aide de caséate ont été réalisées sur une grande partie de la mosaïque. Pour que la matière imprégnées pénètre au revers de la mosaïque, l'imprégnation a été réalisée avec des seringues de 20 à 60 grammes et avec des aiguilles de ponction. Les endroits où la surface de la mosaïque était gonflée, en raison de son décollage furent comprimés avec soin. Seuls quelques rares endroits de la mosaïque de la coupole de la Rotonde, considérés comme dangereux en raison du caractère pulvérent des mortiers furent déposés, principalement au bord des grandes fissures de l'appareil des murs.

c) La phase de la finition esthétique clôtura les travaux de restauration [6] après l'achèvement des imprégnations répétées sur plusieurs années, toujours en été, en raison du surcroît d'humidité.

3e PROGRAMME (COUPOLE DE SAINTE-SOPHIE)

La mosaïque de l'Ascension dans la coupole de Sainte-Sophie (9e siècle) présentait, lors des contrôles réalisés après les tremblements de terre de 1978, un important décollage de l'appareil des murs. Les mortiers du support s'étaient effrités et les risques de chute de la mosaïque était importants. Dans son rapport, G. Koléfas note en 1979 que le pourcentage de décollage est de l'ordre de 30 à 40%. De nouvelles mesures plus précises dans la coupole effectuées en 1983, révélèrent que les vides entre la mosaïque et l'appareil des murs variaient de 1 millimètre à 5-6 centimètres à la base de la calotte de la coupole. Afin de trouver la meilleure solution possible pour résoudre ce problème, une longue recherche fut entreprise par le Service archéologique. L'eventualité d'une application de la méthode connue de la dépose et de la remise en place fut exclue dans la mesure où elle constituait une intervention radicale sur un ouvrage artistique de grande valeur [7] et qu'elle risquait d'alourdir de près de 2.500 kg la surface de la coupole avec un nouveau mortier humide. De même, la proposition de détacher la mosaïque de l'appareil des murs de la coupole ne semblait pas une solution viable et réalisable.

Au cours de la recherche et de l'étude du problème, la restauration préliminaire indispensable fut achevée. Elle comprenait la consolidation de tesselles isolées, le nettoyage des colmatages d'interventions antérieures, la fixation de la membrane en or sur les tesselles d'or, l'entoilage avec de la gaze et de la ouate aux endroits prêts à s'effondrer, et plus particulièrement sur la partie ouest de la coupole qui présentait de nombreuses fissures et enfin le maintien provisoire de la mosaïque avec la pose de clous inoxydables [8]. Enfin, après une longue période de mesures et de suivi du comportement de la mosaïque, il fut décidé de la consolider sur place avec des imprégnations, et plus précisément avec des injections de caséate. Ce travail débuté en 1984 fut achevé en 1990.

En conclusion générale sur ce long travail de restauration des monuments de Thessalonique, il faut préciser que ce travail n'est jamais achevé et exige une attention continue et un suivi scientifique de mesures et de contrôles.

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[6] La restauration des mosaïques de la Rotonde et de Sainte-Sophie ont été réalisées par les équipes spécialisées du Service archéologique dirigées par les restaurateurs K. Georgoussis, A. Kalliontzis, Th. Bogoitsis, A. Paloussis, K. Pappas, S. Marmaras. La finition esthétique a été entreprise par le peintre du musée D. Kamaraki-Zoidi.

[7] E. Kourkoutidou-Nikolaïdou, "Οι αναστηλώσεις των βυζαντινών μνημείων της Θεσσαλονίκης", *Θεσσαλονικέων πόλις – Γραφές και πηγές 6000 χρόνων*, 1997, pp. 46-53.

[8] La consolidation sur place avec des clous a été effectuée après une étude des ingénieurs P. Théodoridis et A. Saklabanis. On a retiré une petite partie des deux premières couches du mortier et percé la troisième ainsi que l'appareil des murs. On a placé un ancrage en titane recouvert d'une gaine (bague métallique et feutre) pour que le clou ait la place pour d'éventuels petits déplacements. Enfin, la dernière couche de mortier a été remise en place.

DISCUSSION

Menicou: [trans.] Up to now we have usually been talking about floors, which are very easy to monitor after conservation. How often do you do follow-up monitoring after conservation?

Kourkoutidou Nicolaïdou: [trans.] In the case of the Saint Sophia mosaic, we have finished the consolidation of the dome. Monitoring the mosaic is possible from the lower level because, of course, that brings us closer to the mosaic, which is so high up. The scaffolding has been taken down since then, but we will have to set it up again. In the rotunda we have the scaffolding, and that is how we monitor. And some of our colleagues here have used the scaffolding to climb up and see these wonderful mosaics. The scaffolding has been in place for over eighteen years now; we will have to dismantle it at some point, of course, but I must say that after the grouting in the dome has been made, the injections, every year we come back to do a check and we find new lacunae. That is why the scaffolding stays in place, the grouting continues, and conservation continues. This has some cost — not very great — but it is a cost in terms of our relations with the public more than in economic terms. And thus the view has prevailed that we have to do as much as we can for this monument. But the consolidation has been completed, the monument is consolidated and secured.

Solar: During the work, was the place open to the public? Was there any explanation of what you were doing? Did the public know what was happening?

Kourkoutidou Nicolaïdou: [trans.] Many announcements were made, both public and scientific, and there were newspaper articles. However, entry was not allowed because the working place was a dangerous place to be. I must say that the whole monument was in danger of collapsing. Two small groups of scientists or students who had asked special permission were granted access to the monument and to the scaffolding as well.



Fig. 1: Rotonde - Niche sud - Phase de préparation.



Fig. 2: Rotonde - Phase du traitemant au revers des panneaux.



Fig. 3: Rotonde - Mosaïque de la coupole.

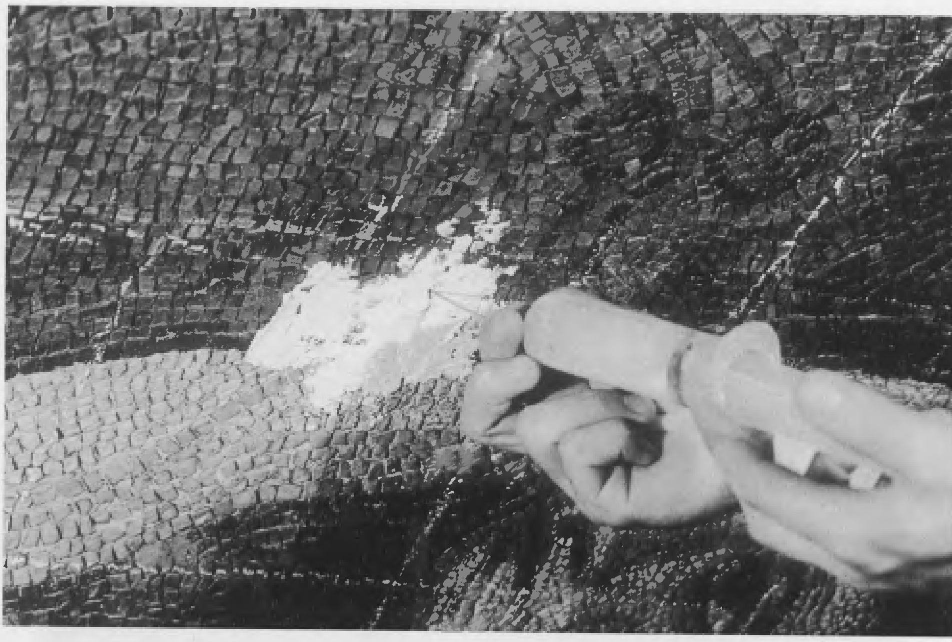


Fig. 4: Rotonde - Phase d' impregnation.



Fig. 5: Sainte-Sophie - La mosaïque de l'Ascension.

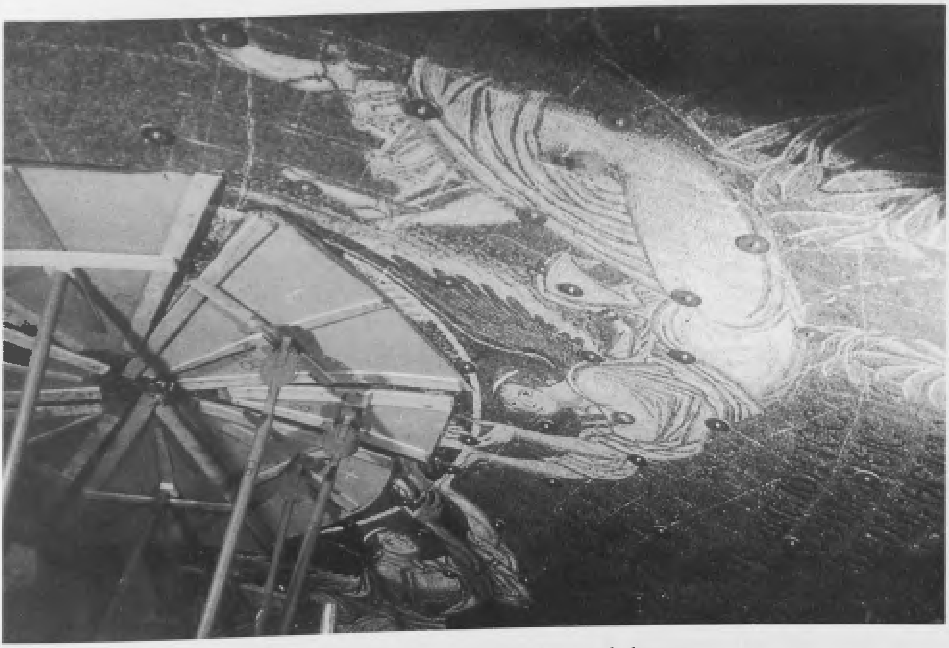


Fig. 6: Sainte-Sophie - Maintien provisoire de la mosaïque.

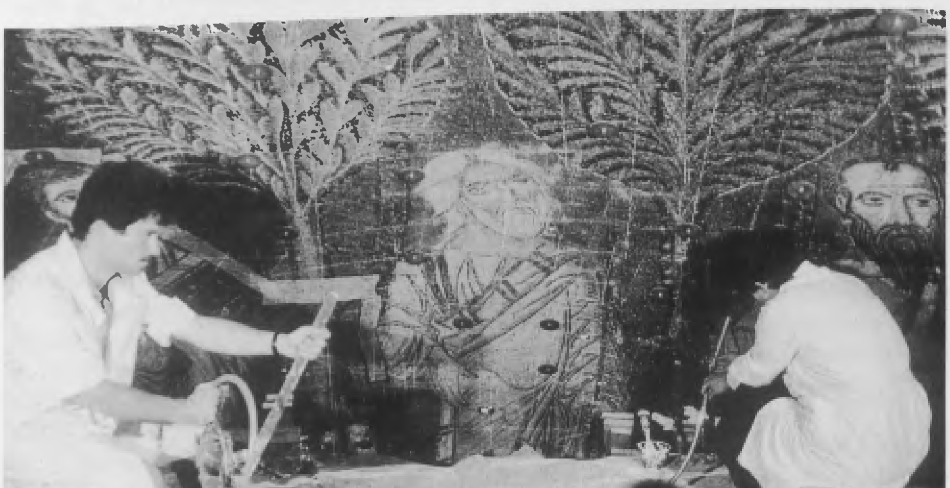


Fig. 7: Sainte-Sophie - Injections de caseate.

Sophocles Hadjisavvas

Developing a World Heritage site: the case of Paphos, Cyprus

Although much attention was paid to the conservation of archaeological objects recovered during excavations in the past, nothing was done towards the preservation of the architectural and other remains. This fact, however, is not surprising as it reflected the priorities of the excavators not only at the beginning of the present century but even of more recent years. It is worth mentioning here that one of the largest and well-staffed archaeological missions in Cyprus during the early 70s included, among a variety of specialists, conservators of metal and other minor objects but none to deal with the extensive remains recovered. As a result of this practice the artefacts are preserved, but all of the fragile architectural heritage has deteriorated to such an extent that the walls uncovered at that time can no longer be traced.

Now we can only regret that the recommendations on international principles applicable to archaeological excavations, adopted by the General Conference of UNESCO at its ninth session in New Delhi in December 1956, were not taken into consideration when granting excavation permits to foreign missions.

As a consequence of the policy of the Department of Antiquities to grant excavation permits without taking into consideration the ever increasing extent of the excavated remains, many sites were left to deteriorate, others were backfilled without having been conserved and those destined to remain open to the public suffered not only from the elements but also from the impact of heavy visitation.

It was only in 1994 when new heritage management policies were adopted by the Department that a circular letter was sent to all foreign missions urging them to excavate to the extent that they could meet the conservation needs of their sites. Meanwhile extensive conservation projects had already been put in hand in 1993 and excavated remains which had not received previous attention were consolidated or backfilled.

The inscription in 1980 of the archaeological sites of Paphos in the World Heritage List, among other far-reaching consequences, resulted in closer relations between the Department and the advisory bodies to UNESCO, particularly with ICCROM. It is therefore natural that one of the first conferences on conservation of archaeological excavations was organized in Cyprus in August 1983. Of special interest for our subject is the continuous collaboration between the Department of Antiquities and the Getty Conservation Institute in the field of mosaic conservation and *in situ* conservation on archaeological excavations. Two such training courses have so far been organized in Paphos, while

the present conference should be considered as a follow up to the previous two. I can only hope that this collaboration will be intensified in the future, and that it will be extended to include the conservation of prehistoric sites of which Cyprus is justly proud.

This introduction may be considered appropriate in order to clarify the changes in heritage management policies which led to the adoption of the Paphos Master Plan, one of the very first initiatives towards the preservation and development of a Mediterranean WHS for touristic purposes.

The purpose and essence of the Master Plan are twofold: firstly the protection of the archaeological sites of Paphos which is the primary goal of the Department, and secondly the creation of conditions which will encourage visitors and accommodate their needs.

In order to accomplish these goals, the objectives of the Master Plan are to create visitor management strategies to ensure better security for the site, and to create designs that improve site presentation and interpretation. Before going into further detail a short description of Paphos will help those not familiar with the site towards a better understanding of the essence of the Master Plan.

Paphos is situated on the SW corner of the island, its location having been selected by King Nikokles in the 4th century BC. Although the earliest habitation of the region goes back to the Chalcolithic period, this particular area attained its importance only after the Ptolemaic supremacy when Paphos became the capital city of Cyprus, replacing Salamis on the east coast, a title which it retained for more than 500 years, including the period of the Roman occupation of the island. The few accessible tombs at the site of the "Tombs of the Kings", known since the romantic 18th century, were the only visited archaeological site in the region.

With the declaration of independence in 1960 large scale excavations were undertaken for the development of cultural tourism, and Paphos, being one of the richest archaeological resources, was no exception. As a result of this work archaeological remains of diverse periods are now accessible to the hundreds of thousands of visitors. Most of the remains which have been uncovered in the area date to the Roman period, but a Hellenistic house with a peristyle court, and pebble mosaics in both excavated and unexcavated areas illustrate life at Paphos during the 3rd century BC.

The splendour of the Roman period monuments is represented by four villas adorned with magnificent mosaic floors. The first to be discovered was the "House of Dionysos", a spacious villa with a peristyle atrium and about 40 rooms on all sides. The excavation of this house was destined to become of paramount importance for the archaeology of Cyprus and the development of cultural tourism. Excavation continued in different places resulting in the uncovering of the House of Theseus, the Odeon, two early Christian basilicas and other structures.

Paphos became the focus of archaeological activities after the 1974 Turkish invasion which led to the occupation of the most visited monuments and sites of the Kyrenia and Famagusta districts. Once again Paphos replaced Salamis, this time as the most visited archaeological site of the island. Only a few years after the invasion the number of foreign visitors grew at a yearly rate of 20%.

In the meantime, in 1980, the archaeological site of Paphos was inscribed on the World Heritage List, adding to the popularity of the region. To save the site from the pressing demand of development the government of Cyprus, through the Department of Antiquities, spent $12 million.

New excavations were undertaken at the Tombs of the Kings, the House of Aion and the House of Orpheus resulting in the recovery of monumental tomb architecture and mosaics of great artistic value.

Three years after the inscription of Paphos as a World Heritage Site the mosaics were visited by 126,000, while 10 years later, in 1993, the same site was visited by 288,000 people. This impressive increase in the number of visitors, although welcome from the financial point of view, constitutes one of the main factors in the deterioration of the site. This impact should be added to natural causes, such as the wind and rainfall runoff, the upward movement of soil moisture etc. In order to face all these impacts, following the recommendations of the UNESCO experts, the Department of Antiquities commissioned, in 1988, Klaus Klein, a landscape architect, to prepare a conceptual Master Plan for the WHS of Paphos. At the same time a specialist in lightweight structures undertook a similar study for the protective roofing of the excavated remains containing mosaic floors. In May 1994 the construction plans were displayed for inspection and comments by the interested bodies and the people of Paphos. It was a happy coincidence that during the presentation of the draft final plans by the architect, a group of conservators from the Getty Conservation Institute was attending the meeting and took an active part in the discussion. All views expressed were taken into consideration and the final plans were amended accordingly. In December 1994 the contract for the implementation of the first phase of the Paphos Master Plan was signed at a cost of $6,070,000 and construction work commenced in May 1995.

The architectural remains of Paphos, although of an urban character, lack the visual values of Ephesos or the completeness of Pompei. This is mainly due to the rather haphazard excavation which focused on individual buildings instead of whole *insulae* of the ancient city. Archaeologists have often been interested in the discovery of mosaics which will bring some fame to the excavators, ignoring other features of the city such as the street system. The resulting pattern is a number of villas without any connection between them which stand as isolated structures in the natural environment.

In an attempt to overcome this shortcoming the architect proposed a pedestrian walkway system to link all major points of interest in the archaeological park. This system of paths and plazas will create an urban environment.

Raised walkways are proposed for the better protection of the excavated remains, while making them more accessible to the visitor. The design is intended to be barrier-free and allows for handicapped access where possible. The proposed boardwalk is designed with wooden planks spanning the width of the boardwalk at right angles to the direction of travel. The planks would be supported by galvanized steel beams to allow great spans and fewer points of contacts with the ground. The contact points should be load-spreading pads in sensitive areas and minimum footings elsewhere.

The proposed raised walkway system will create a very strong and highly visible design element to contribute to its adjacent environment: the excavated remains and the

overhead structures. To facilitate viewing and to prevent the walkways from dominating the site these will be kept low. For visitor safety and security a metal railing system will be used, and this will also carry informative signs. The width of the walkways will allow for two-way pedestrian movement while a wider space will be provided at viewing platforms.

Basic information about the site will be provided in the Visitors' Centre in the form of exhibitions and audiovisuals.

The interpretation will be complemented by signs on plazas close to excavation sites, on boardwalks and viewpoints. Apart from the interpretational signs the archaeological park will also be provided with orientation signs.

The measures described so far are part of the first phase of the Paphos Master Plan which is now in the process of implementation. Other components of the first phase are the fencing of the archaeological park and the construction of a large parking lot. Three viewpoints will be constructed on dominating spots within the site, while a number of plazas will be created near the major excavation sites for the comfort of the visitors.

A series of changes to the original plans had to be made in order to implement the concept of the Master Plan. Trial trenches opened in areas designated for planting led to the cancellation of this part of the project. Mosaic floors and other remains were found only a few centimeters below the surface and any planting would have been destructive. In another case, during the construction of a pathway, a pebble mosaic representing a standing human figure surrounded by dolphins, was exposed nesessitating the relocation of the path. Additional trenches excavated within the area designated for parking led to serious changes which contributed further to the delay of the work.

The second phase, which is more relevant to the subject of this conference, includes the roofing of 8,000 m^2 of excavated remains containing all the significant mosaics apart from those already roofed (House of Dionysos and House of Aion). All the remaining structures, whether permanent or temporary will be removed.

The design concept of the new roofing consists, fundamentally, of a flat roof with varying heights that corresponds to the shapes and uses of the ancient villa. Selective use will be made of translucent, high quality, membrane structures both to highlight important aspects of archaeological significance and to further enhance the general building form.

The decision on the morphology of the roof should create a dramatic contrast to the existing landscape, especially from the direction of the built-up area, as well as from the sea. Furthermore, the morphology should not be incompatible with the immediate environment of the archaeological finds. The materials should not be provocative and the forms should not compete with the exhibits.

Regarding the structural system, it should be such as to ensure the integrity of the exhibits even in the event of unforseen and exceptional stresses such as vandalism, earthquake, storm etc. In such an event the failure, if any, should be partial and local.

Finally, the structural system should allow for ease of expansion, in any direction, according to the progress of the archaeological excavations.

Within these parameters, the final design consists of primarily horizontal elements in laminated wood, supported on aesthetically minimum vertical and diagonal steel columns, with minimal foundation requirements. The weathering layer will be horizon-

tal marine plywood sheeting, with a chemically stable bitumen-based waterproof membrane.

Being in the process of implementation of the P.M.P. I have to admit that it is a painful experience for us. The once idyllic area of Paphos now provides the impression of a huge building site. One day Cyprus may be considered to be a pioneer in realizing a project which in all manuals on WH Site management seems ideal. As an archaeologist I would prefer to have some of the streets excavated and the various villas joined by the original street system of the ancient city. This would give the visitor the satisfaction of moving within an authentic ancient city environment. The construction of several kilometres of pathways and dry-laid walls to substitute the original image will create a constant maintenance problem for the site managers.

DISCUSSION

Name unknown: Could you tell us something about the time frame for this project?

Hadjisavvas: We expect that the project will be completed towards the end of March, 1997, that is the first phase which is the landscaping, fencing and the construction of the two parking areas at the Tombs of the Kings and on the coast. The second phase will start hopefully towards the end of May. We will probably have to invite tenders in March after completion of the first phase because we have problems with the contractors. If the project is not satisfactory, it will go to another contractor; we have problems having two contractors at the same site.

Solar: It is quite unusual to have a master plan for a whole archaeological site. It is not a common thing.

Hadjisavvas: As a point of clarification, since the people involved are not here, I feel we should say that the policy of the Department of Antiquities was slightly lax after the 1974 invasion. We needed people to work here, to come from abroad. I never took any of the decisions, so I am not excusing myself; we needed foreign missions to work in Cyprus, we needed foreign missions to employ Cypriots so the country could get back on its feet. And this is why the regulations were slightly lax after 1974. By 1994 we were back on our feet and we could make much better plans.

Name unknown: With the situation before 1994, you were in the good company of many, many countries around here where archaeology comes first, and it is, I think, quite fortunate that things are changing in various countries. But that was the situation that I knew quite well in Israel, where archaeology came first, and conservation, presentation, development, as well as protection of the heritage, came later. But it is changing and that is a good sign.

Hadjisavvas: Excuse me. I did not mean to criticize anybody. Those were the policies of the time. Today, if we wish to criticize, we can criticize all the conservators who were

working before us, even the archaeologists, because they used older methods. My wish is not to criticize anybody, but just to recount the history of heritage management in Cyprus.

Palumbo: My question concerns the development of archaeological research in Paphos in the future under the master plan. Does the master plan take into account where to dig next, or how to conduct excavations? Also will a programme of research into the topography of the ancient town be conducted so that a better understanding of the city can be achieved in the future?

Hadjisavvas: Of course the master plan takes into consideration the future needs for excavation. This way, for example, the roofing is expandable; we can expand this master plan according to the excavation needs. We have areas which are still under excavation, and they are not taken into consideration because the excavations are still going on. But when the excavations are completed, the master plan will be expanded. The roofing, the landscaping and everything.

Margalit: Maybe it is too late, but I will ask. I come from outside Cyprus. Cyprus is a beautiful island, and Paphos is a beautiful archaeological site, near the sea. Before you decided to undertake this huge development project, did you think about ancient Paphos and look at the historical site, the archaeological site, and think how this tremendous development would change all of the environment of such a beautiful site?

Hadjisavvas: The problem in Paphos was the abrupt social change some years ago, before 1974, when the village consisted of about twenty or thirty small houses. The need to create new accommodation for the tourists led us to proceed with this master plan in order to protect at least the archaeological site which is inscribed on the World Heritage list. As I mentioned in my paper, we spent twelve million dollars to acquire the land, and we are spending now another six or more million to protect the site. Our main interest is the protection of the site. But we cannot do anything to keep the village as it was. That is not our business, unfortunately.

Ben Abed: [trans.] Having the privilege of addressing the head of the Department of Antiquities for Paphos, I would like to tell him that I was quite surprised to note the absence of maintenance on this site, which is so important for the heritage of the world. Are you waiting for the actual implementation of this master plan, or are there additional reasons to explain why this site is unfortunately being lost in some areas?

Hadjisavvas: If I reply to this question, maybe somebody else will say that I am criticizing my predecessors or the Director of the Department. It is true that some years ago Dimitri (Michaelides) excavated the House of Orpheus, and nothing was done to consolidate the mosaics. We have been forced to proceed with huge programmes

of consolidation of remains. We started in 1992 with Khirokitia, and then we proceeded with Kourion and Paphos, and now there are many excavations which have been consolidated. I do not say reconstructed or restored, but consolidated. So we have established the frameworks for this project, we are going to proceed also with the consolidation of all the remains. We started with the House of Dionysos, which was excavated first; now they are working at the House of Theseus, then we will proceed with the House of Orpheus and so on. We plan to consolidate all the excavations. There are so many excavations on the island, and the department is a very small department to overcome all these difficulties. We have to conserve all the excavations, not only those of the Department, but also those of the foreign missions. We are now changing our management policies, and foreign missions now have to consolidate and conserve their own excavations. So it is much easier for us now.

Sivan: Maybe I did not understand, but why did you decide to make artificial roads and not to look for the original streets? And secondly, why did you choose a landscape architect and not an interdisciplinary team?

Hadjisavvas: That is a very difficult question to answer. We had a note from the World Bank, and we had some conditions. So, the World Bank proposed a number of landscape specialists, and that was the proposition of the World Bank. It was not really our decision to get the multidisciplinary commission. Anyway, the architects who undertook to prepare the conceptual master plan contacted many people. The planting, for example, will be carried out by the Forestry Department of Cyprus. There are many other features within the archaeological site which were undertaken by specialized bodies. The architect prepared the conceptual master plan. I cannot say that he decided about everything; he consulted with archaeologists, conservators, the forestry people, the agricultural people, and so on.

Name unknown: Concerning the other question, in fact you did answer it before. Why you decided to make artificial paths and not to excavate the streets.

Hadjisavvas: That was the decision of the architect. I am sorry that he is not here to answer the question. I think the time was pressing and he decided to work with what he had at his disposal. My personal view was to excavate, but would there have been enough time to excavate before implementing the master plan?

Michaelides: On the question of the streets, Sophocles (Hadjisavvas) knows my views, so I will answer Renée. Which streets?

Hadjisavvas: The pathways, you mean?

Michaelides: No, which ancient streets? The city is a city that developed from the beginning, from the end of the 4th century BC to the 7th century AD, always changing the alignment of its streets. It suffered earthquakes again and again. I will only

give you one example of the area we went to yesterday. In the 4th century earthquakes, the House of Dionysos, the House of Orpheus, and all the other houses we know of there were ruined and abandoned. The basilica and the House of Theseus were restored; they were enlarged, and they encroached on what had been streets just before the earthquakes. So, are we going to go back to the streets after the 4th century building, and leave the houses in ruins? Which streets? I mean, it is a complex network of streets. The House of Orpheus is the corner of an insula, of an original insula. We managed to find the outside wall of the Hellenistic building, but the House of Orpheus is sitting on the road. They eliminated those roads and left little alleyways between the big houses. So, it is not Ephesus, it is not Ostia or Pompeii, where you have straight pebbled streets that stayed alive for centuries.

Solar: It is probably complicated, and when I worked with archaeologists, sometimes against archaeologists, in Beth Shean in Israel we tried to convince them to excavate the streets first and then the buildings from the streets. They did not want to because it is quite boring to excavate streets. But at Paphos there are different layers, and there are dilemmas.

Skaf: Is there any reason why you chose to build the parking lot and the landscaping before the shelters? Because if after one year you end up with a parking lot and landscaping and you have a problem with your developer, what will you do? You will have a parking lot and landscaping and no shelter for the mosaics.

Hadjisavvas: It is a matter of phasing. Our final goal are the shelters for the mosaics, of course, and the remaining archaeological site. First we wish to undertake the work on the ground and then the above-ground structures. We are not worried. We are going to finish it. We have the plans ready, and if you come after a couple of years, you will see the roofing.

Guex: [trans.] I do not envy you for the great responsibility you have to preserve these formidable marvels that we had the privilege of seeing. For people coming from small countries, it is always a difficult task to give opinions. However, I would like to ask you whether you have a budget available to undertake emergency work, in particular, repair of fences, because unfortunately nowadays we have wild visitors who decide to trample on mosaics. Also, would it be possible to provide for the placing of some corrugated sheets wherever you have water leaks? I am talking about maintenance work that would enable you to save a lot of money in the future.

Hadjisavvas: Everything you mentioned is included in the master plan: the protection, the fencing of the excavated remains.

Hergué: Before implementing the master plan do you have to undertake any major works?

Hadjisavvas: Before implementing the master plan, we have what you saw yesterday in Paphos. We have all these shelters, but they are constructions which in many cases

had the reverse results to those desired. Some small, low shelters, for example, which were constructed above the mosaic of Achilles, they were destructive because they created a microclimate which in the end was destructive. It was not protective. And I have some of my conservators here; they can tell you that the mosaic which was left outside this shelter is better preserved than the one inside. We have had these bad examples. It is better not to proceed with any ephemeral constructions but to go forward for a good one. It is better to cover a mosaic. The new ones, for example, which were found during the construction work, we backfilled them immediately. And we will keep them backfilled until the roofing is extended to this area. We are not going to excavate them just to show that we have more mosaics in Cyprus. They will be there. So, I think that it is better to proceed with a good roofing system rather than doing premature work. And it was not the problem of money; we have money. Cyprus is a rich country now. I do not blame the government, they always give the money. But we have other problems which prevent us from proceeding immediately. It is a matter of people to do the job and sometimes the bureaucracy.

Chantriaux-Vicard: [trans.] I would like to stress what has been said. I think a new survey should be carried out now before the master plan is implemented; I think there are some mosaics in a very perilous state of being modified such as the Amazon next door to Orpheus, which was previously covered by the roof, and the roof has been reduced due to the wind effect. And now the Amazon, which has been reburied and backfilled, suffers from water coming off the shelter over the mosaic. And I think there are cases where protection is necessary immediately to prevent inexorable damage.

Hadjisavvas: We treat each case separately. We do not have a general policy. If we find a mosaic and it has to be protected immediately with a kind of shelter, we proceed. This particular mosaic which you mentioned will be protected; it will be under the roof.

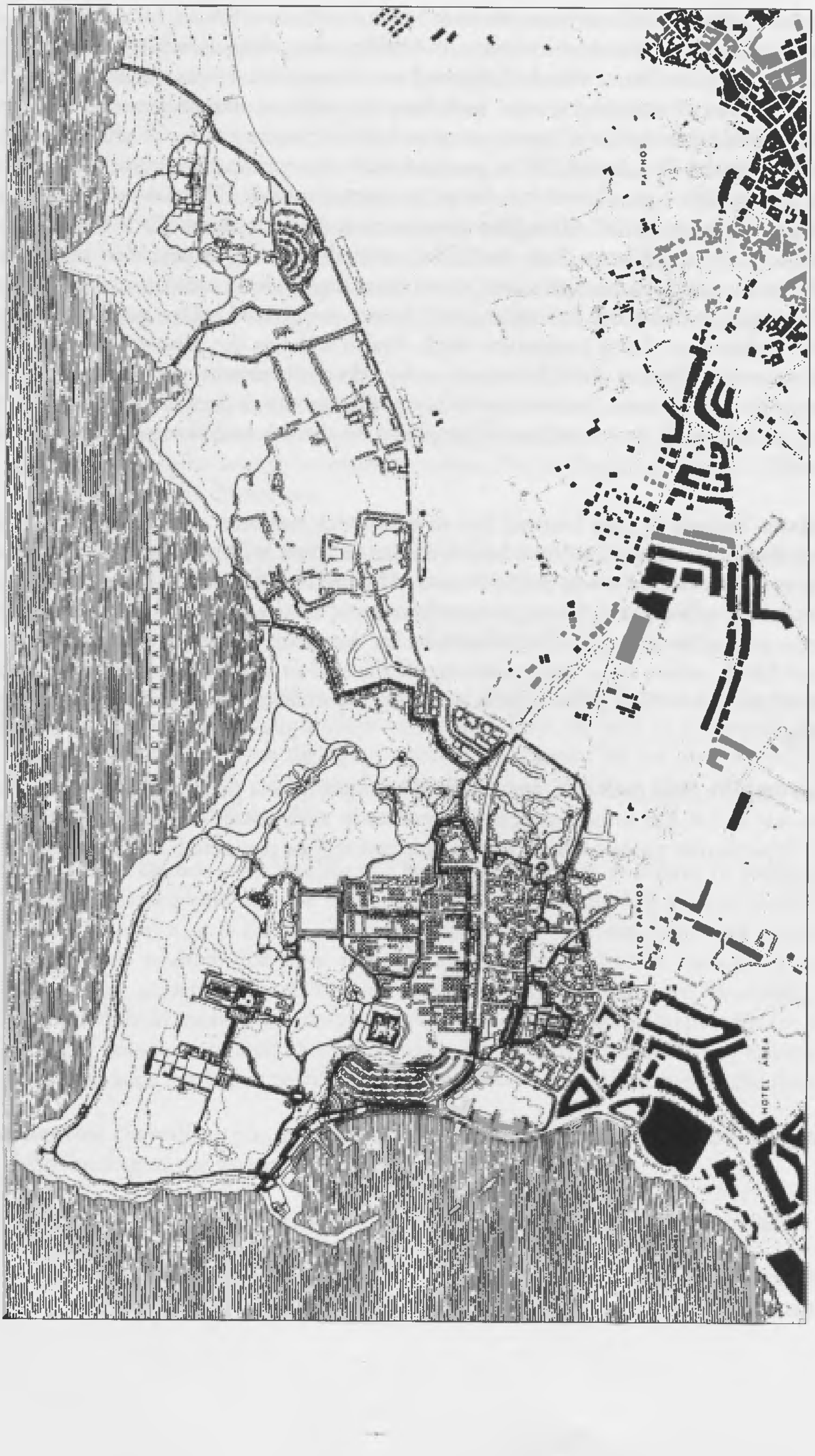


Fig. 1: The Paphos master plan.



Fig. 2: The new ticket office under construction.



Fig. 3: Dry-built stone walls marking unexcavated area.



Fig. 4: Filling in of the agora floor and metal fence.



Fig. 5: One of several newly constructed observation points.

Michele Piccirillo and Claudio Cimino

Protecting and preserving the mosaics of Jordan: the Madaba Mosaic School for mosaic restoration

After more than twenty years of uninterrupted archaeological work, we feel more and more concerned about the conservation and preservation of the historical, artistic and cultural heritage of the region in which we operate. Our primary concern is related to the restoration and preservation, in their natural setting, of the mosaic floors of the Byzantine-Ummayad periods that we have unearthed and published [1]. In October 1992, thanks to the cooperation of the Italian Government, the Madaba Mosaic School was opened. The creation of the School is an offshoot of the archaeological excavations carried out in the Madaba region, where Mount Nebo, the base camp of our archaeological mission, is located.

Our interest in the restoration of mosaics in Jordan started in the summer of 1973 when we joined a rescue team sent by the Franciscan Custody of the Holy Land to Mount Nebo to restore the mosaic floor of the Church of Saints Lot and Procopius at Khirbat al-Mukhayyat. In 1976, with a second Italian team, we started the restoration of the mosaic floors in the northern chapel of the Memorial of Moses on Mount Nebo. This resulted in the discovery of the ancient baptistry of the sanctuary, one of the masterpieces of the mosaic workshops of Madaba. In 1977-82, our archaeological team intervened in the Church of the Virgin in Madaba with the discovery of the Saint Theodore chapel in the cathedral and of the mosaic of Hippolytus. In 1984-86 we discovered new mosaic floors in the churches of the ʿUyun Musa Valley. In 1986 archaeological excavations started at the ruins of Umm al-Rasas in the steppe 30 km. south of Madaba.

Archaeological excavations carried out in recent years both by foreign archaeological missions and local Jordanian institutions have substantially increased the amount of ancient mosaics uncovered that have to be administered by the Ministry of Tourism and Antiquities which does not possess the know-how and the infrastructure to care for these

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[1] See the recent comprehensive publication: M. Piccirillo, *The Mosaics of Jordan*, Amman 1993; M. Piccirillo and E. Alliata, *Mount Nebo. New Archaeological Excavations 1967-1997*, Jerusalem 1998; M. Piccirillo, *Chiese e mosaici di Madaba*, Jerusalem 1989, and the more general catalogue of the exhibition held in several Eureopean cities starting in Rome: *I Mosaici di Giordania*, Rome 1986 (with French, German and Danish editions).

mosaics[2]. This increase raised concerns regarding the conservation and restoration of those artistic remains that, after being uncovered, need proper treatment and maintenance to permit their display in an appropriate context.

This concern was the reason behind the idea of the Madaba Mosaic School which we suggested to the Jordanian authorities in 1982; we felt that this was a priority if the Government wished to intervene in this matter definitively in the right direction for the preservation of this important part of the historical-cultural heritage of Jordan.

The need to create new job opportunities by reviving traditional handicrafts, combined with the efforts aimed at preserving ancient mosaics, created the conditions for action to be initiated. Taking this into account, a request was made on behalf of the Jordanian Ministry of Tourism and Antiquities to the Italian Ministry of Foreign Affairs to set up a school for the restoration and conservation of ancient mosaics and the production of modern mosaics in the city of Madaba. The Madaba Mosaic School was established as part of the Italian cooperation project with the Jordanian Government. The School was opened in the compound of the Madaba Archaeological Park, inaugurated by Queen Noor al-Hussein on November 12th 1995, created in the centre of the city thanks to a grant made available by USAID (United States Agency for International Development) through the US embassy in Amman and by the Canadian Government.

The Madaba Mosaic School is a Jordanian-Italian project currently preparing young Jordanian experts in the field of mosaic restoration. This will enable them to take care of the rich heritage of ancient mosaics in Jordan themselves. The aim of the school is to create the know-how and manpower not only to restore and maintain the mosaics that have been uncovered in recent years in the Madaba area and elsewhere in Jordan, but also to produce modern mosaics.

The Madaba Mosaic School is the only secondary school specializing in the field of restoration in Jordan and the Middle East. The school is designed to offer a three year academic programme focusing on ancient mosaic restoration and modern mosaic production. Applicants from all over the Kingdom who have successfully completed tenth grade with a minimum average of seventy five are interviewed, and a maximum of fifteen students are accepted per year. During the first two years students follow the Ministry of Education Industrial stream programme and are also given specialized courses such as History of Art, Technology, Professional Drawing, Workshop, Mosaics and Mosaic Restoration. Those who successfully pass the entrance exam are enrolled in the third year. During this year the students focus intensively on mosaics and study a variety of methodologies of restoration applied to different case studies in addition to the production of

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[2] Cf. M. Piccirillo, *The Mosaics of Jordan*; *idem*, "Il problema del restauro dei monumenti in Giordania", in L. Marino (ed.), *Conservazione e manutenzione di manufatti edilizi ridotti allo stato di rudere, Report* 1, Firenze 1989, pp. 73 s.; *idem*, "Il Parco Archeologico e la Scuola del Mosaico a Madaba in Giordania. Cronistoria di un progetto", in L. Marino (ed.), *Siti e Monumenti della Giordania. Rapporto sullo stato di conservazione*, Firenze 1994, pp. 53-56.

modern mosaics using various techniques. The school was fully furnished and equipped with the necessary items through the Italian contribution.

The goals of the Madaba Mosaic School include the accommodation of mosaics already restored but not shown because of the lack of a proper space, and the performance of periodic maintenance and simple restoration of the ancient mosaics in Madaba and the surrounding area as required.

In the summer of 1993 the students completed a three month training course on site restoration techniques of ancient mosaics, under the supervision of Italian experts. This summer experience, sponsored by USAID, was repeated in 1994. During the same period, the students also attended a course in the production of modern mosaics.

During the winter of 1995 the third year students were requested by the Department of Antiquities and by the Franciscan Archaeological Institute to intervene in the restoration of Byzantine mosaics at Jerash, Mount Nebo and Umm al-Rasas under the direct supervision of Italian experts. In the Madaba Archaeological Museum, the Paradise mosaic has been restored together with the Apostles Church mosaic floor; on Mount Nebo the Theotokos Chapel in the Wadi ʿAyn al-Kanisah and the floor of the Church of the Martyrs Lot and Procopius were also restored.

Sections of the mosaic floor of the Hippolytus Hall under the Church of the Virgin, previously exhibited in the Museum of Folklore in Amman, were relaid on their original site after they had been provided with a new light support. Experiments were carried out for the first time on the use of appropriate technologies for mosaic restoration in Jordan. At the same time, sections of the mosaic floors of the Church on the acropolis of Maʿin and of the church in the village of Massuh were displayed on the walls of the new museum in the Park compound.

On the occasion of the first centenary of the discovery of the Madaba map, a life-size copy of the map made by the students was shown during the international colloquium held in Amman on the 7-9 April, 1997.

The realization of the inadequacy of the industrial stream of the education curriculum to fulfil the academic needs and requirements of the Madaba Mosaic School motivated the experts responsible for the set-up of the school curricula to submit an official request to develop a proposal for the introduction of a new stream in secondary education which reflects the needs of the school more adequately. We are, therefore, trying to upgrade the school to a higher level under the umbrella of the Jordan or the Yarmouk Universities.

Through an agreement between the Madaba School and the Director of the Opificio delle Pietre Dure in Florence, the students, after graduation, will participate in a three month restoration programme in Italy.

Since the discipline of restoration is totally new in Jordan, there is a need to provide professional follow-up in terms of management and field expertise. This will provide those who decide to undertake restoration as a career with the needed technical assistance and professional upgrading necessary to ensure that their professional performance meets the established standards. It is hoped that this will evolve into a "National Board of Restorers", which is expected to be a natural result of such high level technical assistance.

DISCUSSION

Solar: I have the impression from what I have seen that all the mosaics are lifted and put on panels as a systematic procedure.

Piccirillo: That is the wrong impression. We do not do that unless it is necessary, and I disagree with opinions voiced here earlier in this conference. Each case has to be examined individually. In that particular case the surface was bubbling up and part of the medallion was completely destroyed because somebody went in and stepped on it. Some restoration was undertaken *in situ* year by year but in a way that was impossible to reverse. The surface had risen 20 cm. And someone sealed it with concrete. How could it be restored? Knowing the problems, we decided to remove the mosaic and replace it on the spot.



Fig. 1: Queen Noor al-Hussein at the opening ceremony of the Archaeological Park and the Madaba Mosaic School, on November 12th, 1995.



Fig. 2: The Mosaic School in the Madaba Archaeological Park.



Fig. 3: Students and partly completed copy of the Madaba map mosaic, made on the occasion of the celebrations of the first centenary of its discovery in 1997.



Fig. 4: Restoring the removed western section of the Hippolytus mosaic.

POSTERS

partly [illegible] of the Madaba map mosaic made on the [illegible]cation of the [illegible] of its discovery in 1897.

Restoring the removed western section of the Hippolytus mosaic

Sophocles Hadjisavvas

Developing a World Heritage Site: the case of Paphos, Cyprus

The 1974 Turkish invasion of Cyprus resulted in the occupation of the Kyrenia and Famagusta Districts. The most important archaeological sites were lost, together with 70% of the island's tourist infrastructure.

After the invasion, all of the efforts of the Department of Antiquities were directed toward the regions of Paphos, Kourion and Amathus, situated near the new tourist destinations. Paphos gradually became the focus of archaeological activity, particularly after its inclusion by UNESCO, in 1980, in the World Heritage List.

After realizing that the region's rapid urbanization and tourism development were causing irreparable damage to the cultural environment, the archaeological site was acquired at a cost of $12,000,000.

The impressive increase in the number of visitors encouraged the authorities to proceed with a protection plan for the archaeological site, while upgrading the surrounding environment as an integrated tourist area. Following the recommendations of UNESCO experts, in 1988, the Department commissioned a landscape architect to prepare a Conceptual Master Plan for the protection and preservation of the World Heritage Site of Paphos. This first step was followed by the preparation of detailed plans and tender documents. In December 1994, the contract for the implementation of the Master Plan was signed at a cost of $6,070,000. Construction work commenced in May 1995.

The prime goal of the Master plan is to provide protection for the World Heritage Site and at the same time to encourage visitors and to facilitate their visit. The ancient remains will be protected by controlling pedestrian traffic through an organized system of raised walkways. Understanding of the site will be improved through clear, informative and attractive signs. An important addition to the major archaeological site of Paphos will be the Visitors' Centre which will accommodate a variety of functions that are important to the visitors' comfort. A small site museum with a bookshop will be included, and a lecture hall will provide facilities for audio-visual presentations and special exhibitions. Traffic will be kept outside the archaeological site in large parking areas.

The final goal of the Master Plan is the roofing of the mosaics which will be realized as the second and most important phase of this undertaking. It is hoped that tenders will be invited before the end of 1996. The estimated cost for the construction of the 8,000 m² roofing is $4,200,000.

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Jacques Neguer

The Promontory Palace at Caesarea

INTRODUCTION

The Promontory Palace at Caesarea, located east of the site's popular Roman Theatre, was first excavated in 1978. Although visible and tempting to archaeologists years earlier, excavation of the structure was impeded by the recurrent rising of the tide which submerged most of the palace. Limited probes revealed the plan of a large central room, measuring 11.2 x 8.2 m, flanked on its northern and southern sides by a pair of smaller rooms (triclinia). A stylobate constructed along the western side of the central room opens onto a majestic pool (35 x 18 m), encircled by a peristyle on its northern, western and southern sides. A fourth room probably served as the entrance to the structure; constructed on the same north-south axis as the other rooms, it contained successive floor levels, with the later addition of a staircase and further evidence of use and repair.

While the construction of the building, incorporating massive, finely hewn ashlars, attests to the earlier grandeur of the palace, the elaborate mosaic floor decorating the central room overlooking the pool confirms the structure's former nature. Found in almost complete condition, the central panel bears a geometric pattern reminiscent of the *opus sectile* flooring of the period. The 5.2 x 2.5 m central design was decorated successively with a repetitive cross pattern, a black line and furthest from the centre, a red border. The sea has, however, over the years, damaged much of the mosaic, and only about one-third now remains intact.

During the summer of 1993, the archaeological expedition of the University of Pennsylvania raised the question of the possibility of lifting the central mosaic of the triclinium. Three alternatives were discussed:

1. Lifting of the central mosaic and exhibiting it in a museum.
2. Lifting of the mosaic, creation of a new support and return to its original position.
3. Leaving the mosaic *in situ.*

The first method would have deprived the mosaic of its historical and archaeological context, and might have resulted in the physical destruction of the remaining part. The second alternative was not chosen, as lifting would not solve the problem of preservation on the site, and materials for the new support do not perform well enough in the adverse climatic conditions of the site.

In order to prove the feasibility of the third proposal, a one-year experimental plan for preservation of the site was created. This plan was later extended to a long-term conservation, monitoring and maintenance programme.

PRESERVATION PLAN

Certain important factors must be borne in mind when formulating any preservation plan. The complex is located on the coast and is liable to incursions from the sea. From the architectural point of view, apart from the Western Wall foundation, the evidence is generally negative with the location of the foundations visible as cuttings in bedrock. The site is visited year-round by tourists and fishermen. After the 1976 excavation, and until 1993, no attention was paid to the preservation and protection of the excavated remains. This is the general cause of the deterioration of the mosaics on the site.

The preservation plan incorporates the following activities:

1. Recording the physical condition of the site.
2. Consolidation of borders.
3. Cleaning the periphery of the mosaics, building a rubble support at the base and borders of the mosaics (the walls were absent).
4. Plastering of all consolidations with lime-based hydraulic mortar.
5. Lacunae consolidation, filling with lime-based hydraulic mortar.
6. Grouting (not included in the programme, however, every void space was marked on maps).
7. Consolidation of all existing remains of walls (all plaster was consolidated within two years).
8. Protection plan.
9. Covering: plastic net, geotextile, geotextile bags filled with tuff. The choice of covering system had, as a target, the working together of the system: plastic net was chosen as it spreads loads and tensions over the whole surface; geotextile for its relative resistance against biological deterioration, and sandbags to stabilize the cover (more than one bag needs to be lifted in order to expose the floor).
10. Protection: a powerful crane was used to create a breakwater. Each boulder was pre-cut to provide a flat base to facilitate the laying of the stone on the ground. If the project should develop, these boulders will be transferred to the northwestern side of the complex for further protection, while the original wall on which the breakwater now lies will be reconstructed.
11. Conservation, restoration and exposition planning, involving full conservation of mosaics and plasters, partial rebuilding of the walls from the sea side, restoration of the protective wall where the boulders are now located, restoration of mosaics in the form of the original room, partial restoration of the decorative elements (of the central mosaic), construction of walkway for visitors.
12. Maintenance and monitoring involving permanent observation of the site and periodic intervention when required.

OBSERVATION RESULTS

No visible change was noted in 1994. In 1995, some of the sandbags had been damaged and they were replaced. A conservator opened up one part of the mosaic for examination. No damage was observed and the mosaic was covered again. In 1996, a large number of the sandbags had been destroyed by the movement of numerous tourists and fishermen over them.

INTERVENTION

The three mosaics were uncovered, cleaned and photo-documented. No physical damage or changes of status were observed. 1,500 sandbags were replaced, unfortunately with Utah sandbags. Over the layer of sandbags, an additional layer of geotextile was laid and covered with clean dune sand. Finally, a special walkway was constructed through the site for visitors.

FUTURE OF THE SITE

The opening of the Promontory Palace area, and in fact of the whole Caesarea Complex, to visitors will not be possible without special protection.



Fig. 1: The mosaic of the central room.



Fig. 2: The site after covering.

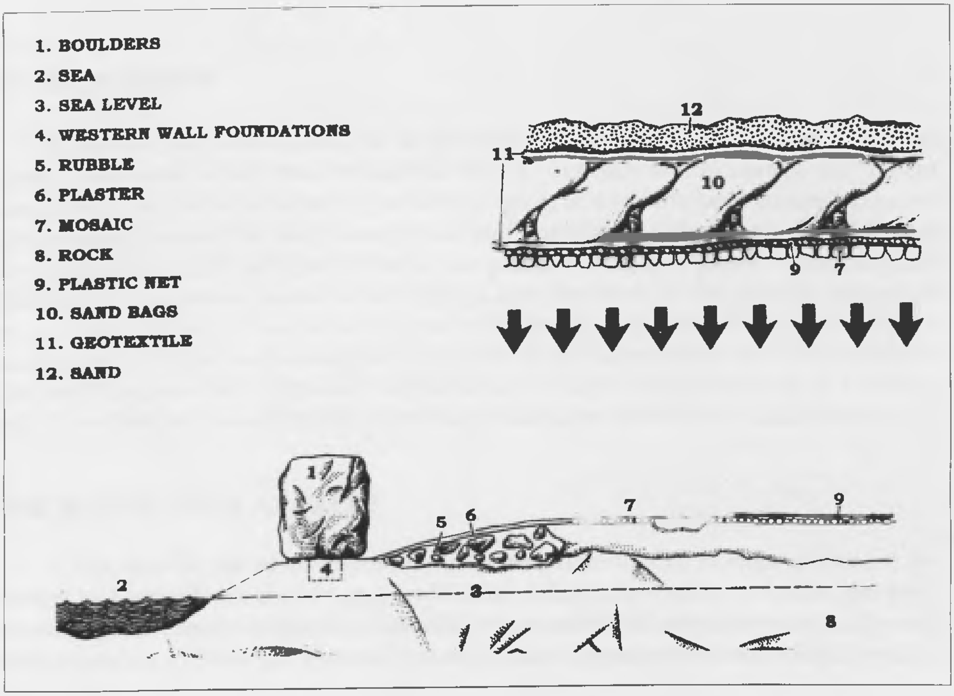


Fig. 3: Graphic presentation of the intervention.



Fig. 2: The site after covering.

Trinidad Pasies Oviedo and Begoña Carrascosa Moliner

The mosaics of Valencia: current situation of conservation and restoration. The case of the pavements of Calpe (Alicante, Spain)

INTRODUCTION

Calpe has long been known for its important archaeological remains, especially the mosaic pavements which were revealed in the 18th century. Unfortunately, the present condition of the Valencia mosaics is not encouraging, and we have been compelled to undertake urgent action for their conservation and restoration. Others have already noted the inexplicable neglect suffered by the Roman pavements in this region [1]; Cavanilles made drawings of the mosaics found in the villa at Calpe, but most of the mosaics themselves are no longer extant [2]. This project of preservation and restoration of the archaeological monuments of Calpe is sponsored and financed by the Department of Culture, Education and Science of the Community of Valencia. It is hoped that it will serve as a starting point for other proposals directed toward the preservation of mosaics in the Valencia area.

THE ROMAN VILLA AT CALPE

Calpe was the site of an important and extraordinarily rich Roman settlement excavated by Cavanilles in the 18th century. Further information on the town has also been revealed by more recent excavation. Cavanilles excavated in the zone known as the Queen's baths according to Llobregat Conesa [3], where he found a group of mosaics which he back-

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[1] T. García de Cáceres Izquierdo, "Mosaicos romanos de la Provincia de Valencia", *Crónica del IV Congreso Arqueológico del Sudeste Español (Elche 1948)*, Cartagena 1949, p. 411; T. Pasies Oviedo and B. Carrascosa Moliner, "Sistema de Catalogación de los conjuntos musivos de la Comunidad Valenciana: proyecto metodológico para su Conservación y Restauración", *Actas del XI Congreso de Conservación y Restauración de bienes culturales (Castellón 1996)*, Diputación de Castellón 1996, pp. 467-475.

[2] Only one of the fragments was extracted from the villa, and it is now preserved in the Museo Arqueológico de Alicante. See A.J. Cavanilles, *Observaciones sobre la Historia Natural, Geografía, Agricultura, Población y Frutos del Reyno de Valencia*, Madrid 1775, pp. 229-231; A. De Valdecarcel, Comte De Lumiares, "Iscripciones y Antigüedades del Reyno de Valencia", *Memorias de la Real Academia de la Historia* VIII, 1852, p. 21.

[3] E. Llobregat Conesa and J.F. Ivar, *Historia de l'art*, Valencia 1986, p. 63.

filled. *Opus sectile, spicatum* and *tessellatum* mosaics were found at that time, and another *opus tessellatum* pavement of unusually large size was found in 1996 within a circular room. This was excavated almost in its entirety; its condition is extremely fragmentary, Christian graves having been dug through the mosaic during subsequent reuse of the building. The central emblem of the mosaic has been totally destroyed, but the richness of its decoration is still apparent from the surrounding designs. Approximately 15% of the mosaic surface survives, but lines preserved in the underlying mortar allow the reconstruction of more of the design.

The condition of the extant parts of the mosaic is fragile. The mortar is weakened by the penetration of a network of roots. Recurrent changes in temperature and humidity according to the different seasons have resulted in surface tension and movements in the surface of the mosaic causing the shattering of some tesserae, blisters and the lifting of parts of the tessellatum. Furthermore, soluble salts derived from the coastal sand dune setting of the site have caused irreversible damage to the different mortar layers and to the black tesserae which are very porous and which have now disintegrated.

The intervention described here comprises initial urgent preservation designed to consolidate and protect the fragmentary remains and to arrest deterioration. Cleaning of the remains was followed by photographic documentation. Definitive restoration work remains to be undertaken, and the ultimate fate of the mosaic has yet to be decided.

CRITERIA UNDERLYING THE INTERVENTION

Although different types of mosaic pavements occur in the area, formed of different materials and suffering different problems, our objectives were:

1) To re-establish the cohesion of all of the layers which comprise the work from the initial layer of preparation to the final mortar layer in which the tesserae were set;
2) To concentrate on treatment that allows the preservation *in situ* of the remains and to respect the integrity of the mosaic as a whole;
3) To re-establish the cohesion of all of the layers which comprise the work from the initial layer of preparation to the final mortar layer in which the tesserae were set;
4) To ensure that all treatments are reversible;
5) To undertake tests to establish the suitability of different products and materials prior to use;
6) To stress the importance of cleaning treatments following the guidelines of a controlled intervention;
7) To safeguard and protect the various mosaic fragments in anticipation of definitive restoration to be undertaken thereafter;
8) To increase awareness of, and respect for our cultural heritage through this scientifically responsible intervention.

PERIMETER PROTECTION AND CLEANING TREATMENTS

The large number of gaps in the mosaic indicated that perimeter protection was urgent in order to prevent the detachment of further tesserae. A natural mortar made of lime and sand was employed for this protection since it is firm but it can easily be removed mechanically if required. The mortar was applied to all of the perimeter and to the gaps within the mosaic. However, several small internal gaps that seemed to be protected by a compact earth filling were simply consolidated with a 5% solution of Primal AC while awaiting final cleaning and consolidation.

Since the mosaic had only recently been excavated, it had not suffered from intense biological attack or tenacious calcareous or siliceous concretions. After initial testing to establish the most suitable method, the first treatment was a mechanical cleaning with soft brushes and sponges, used with distilled water diluted with 10% neutral soap and disinfectant. In the case of fragments affected by non-soluble concretions, a chemical-based treatment was employed with cellulose packs and solutions (sodium bicarbonate, ammonium bicarbonate, Neo Desogen and EDTA) which were allowed to act for 12 or 24 hours before being neutralized.

CONSOLIDATION PROCESS

The vast majority of fragments of the mosaic were suffering from problems of adherence to the original support and required consolidation. This was undertaken initially several months after the mosaic was excavated. However, further damage was subsequently noted, and it was clear that thermal changes, together with the fragile condition of the mortar, were causing serious tension, movement and irreparable damage to the mosaic surface.

Our experience has shown that localized consolidation or patching does not provide an effective solution to the problem. The nucleus mortar layer needs to be cleaned, and the lower rudus layer which is disturbed by roots. Before working on the mosaic surface it is necessary to tackle the problems of the underlying mortar layers, and to ensure that the lime stratum in which the tesserae are fixed is as firmly bonded as possible to the mortar layers.

Satisfactory results have been achieved by the localized injection of new mortar, compatible with the original materials, composed of lime, marble dust and acrylic resin. This provides consistency to the support and restores the qualities of adherence and resistance (one part Primal AC 33, one part lime, two parts water, one part marble dust). Apart from its good penetrability, it has the added ability to restore cohesion and adherence to the original layers, and the treatment can be repeated as often as necessary.

In some cases the situation of the tesserae is particularly precarious. As a result of strong underlying pressure the tesserae have been sprung from their original position and piled up. Nevertheless, the same consolidation methodology can be followed, and the tesserae can again be placed in their new mortar layer, thus restoring the appearance of the original design.

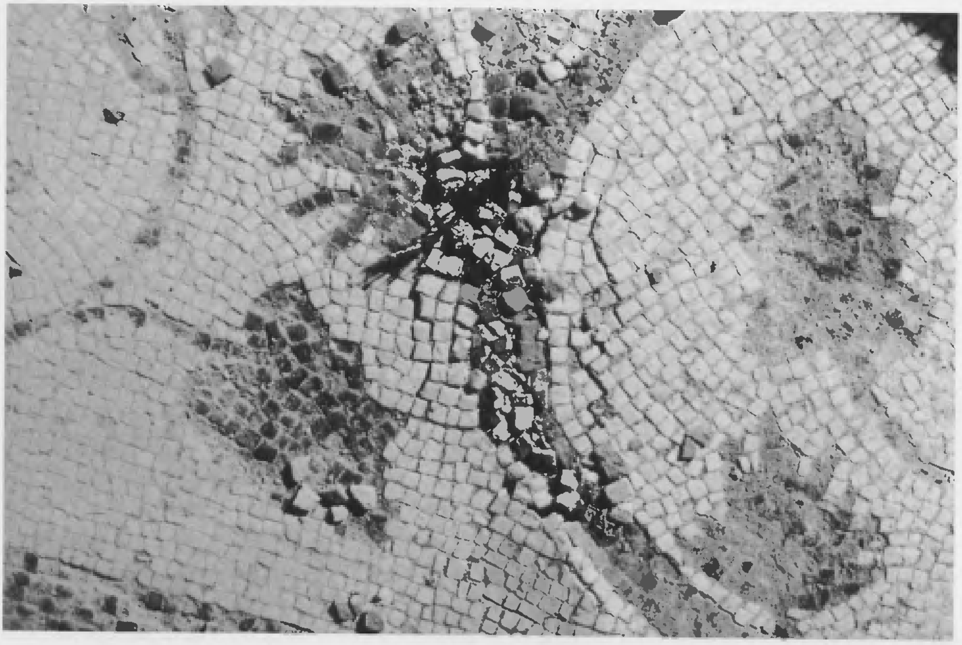
CONCLUSION

The consolidation measures described here represent urgent intervention to safeguard the mosaic. However, it is clear that these measures should be followed as soon as possible by the final restoration process. If a mosaic is left without attention for a long period of time it is prone to biological attack, not to mention damage by human action which may be far more deleterious than natural deterioration. The maximum degree of continuity is advisable throughout the process of consolidation and final restoration. It is to be hoped that our work at Calpe will further encourage consciousness of the importance of preservation of mosaics *in situ*.





Figs 1 and 2: The condition of the extant parts of the mosaic is fragile.





Figs 3 and 4: The majority of fragments of the mosaic were suffering from problems of adherence to the original support and required consolidation.



Figs 5 and 6: The mosaic after application of mortar and initial treatment.

Cleopatra Papastamatiou

Temporary restoration method for mosaic floor fragments

INTRODUCTION

The temporary restoration method provides the restorer with the opportunity to reunite, at any moment, floor mosaic fragments thereby enabling the display of the floor as it originally appeared, without, however, requiring the permanent reunion of the various fragments.

OBJECTIVES

1. To facilitate the study and temporary display of a restored floor that has been stored in deliberately separated sections.
2. To resolve the aesthetic disruption caused to a mosaic floor when it has been separated into such fragments or sections.

METHOD - MATERIALS

The method is based on the way in which the new mortar is attached to the underside of the fragments.

Its difference from other methods lies in the fact that the floor is treated as an unbroken whole during this phase of restoration.

Stages: (Figs 1, 2, 3, 4 and 5)

- After removing the old mortar, the fragments are joined together on the underside at precisely those points where they have been separated.
- Between, and along, the edges dividing the broken pieces copper foil is placed vertically.
- The fresh mortar is spread evenly across the reverse side of the whole floor.
- Once the mortar has hardened and dried the copper foil is removed. The fragments are turned over to reveal their upper surface and the material that held the tesserae in position is removed.

RESULTS

1. The edges of each fragment and its neighbouring fragments are formed into a single perfectly adjoining surface, without any surplus mortar between.
2. The likelihood of distortion or warping is avoided since the physiochemical process during the hardening of the new mortar is spread evenly across the entire surface.
   The result of the above is complete contact between the pieces, without any breaking points remaining to view.
3. Following the temporary reconstruction of the single floor it is possible to separate the fragments once again because the copper foil between them has prevented their permanent reunion.
   The floor may then be stored again easily.

CONCLUSIONS

This method combines the advantages of dividing the complete floor into separate pieces (for storage or in order to facilitate restoration work) with respect for the aesthetic appeal of the original, complete ancient floor.

It can be applied to most kinds of mosaics.

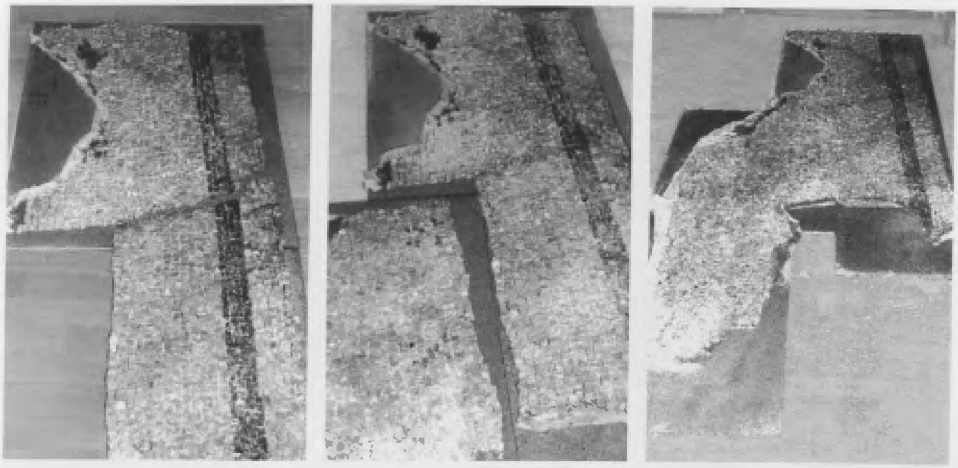
It should be pointed out that the technique proved to be particularly effective in reconstructing floors without regular arrangement of tesserae or clear joints (Fig. 6).

With mosaics made of very small tesserae this technique does not provide strong edges between the pieces. In this case it is important to be particularly careful when storing the pieces.

Essential prerequisites for the successful application of this method are the following:

- The mosaic should have been separated with great precision at the joints between the tesserae, without any rows of tesserae having been removed (Fig. 7).
- There needs to be a large enough covered area for the task to be carried out since the floor must be laid out in its entirety. If such an area does not exist the floor may be reconstructed in sections.

a) b) c)



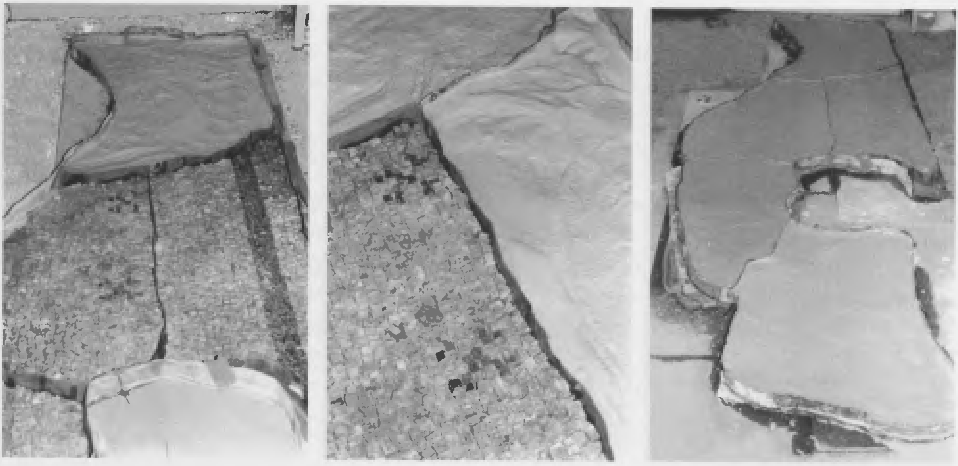
Figs 1a, b and c: The phases in the rejoining process. The fragments are reunited at precisely the point where they have been separated.

a) b)



Figs 2a and b: Placing the copper foil between the edges of the pieces that are to be rejoined.

a) b) c)



Figs 3a, b and c: Mortar is applied to the underside of the floor. The copper foil prevents the mortar from penetrating between the fragments and serves to make a contact surface at the edges of the fragments.



Fig. 4: The copper foil prevents the fragments from becoming stuck to one another. Once the mortar has dried the copper foil is removed thus enabling the fragments to be separated once again if required.

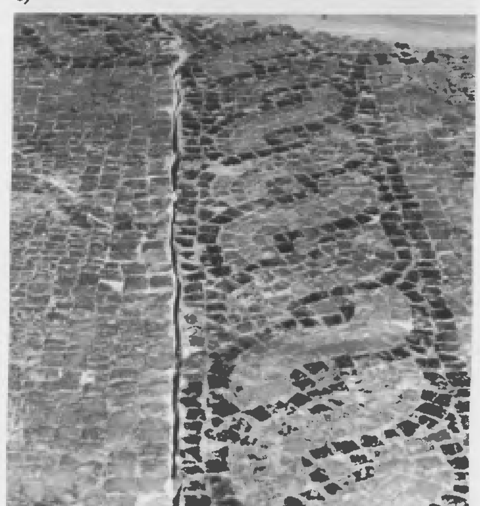
a)



b)



c)



Figs 5a, b and c: Perfect contact between the fragments after restoration. Once they are joined it is possible to form a clear picture of the original mosaic.



Fig. 6



Fig. 7

CLOSING SESSION

Recommendations

read by Aicha Ben Abed

The Committee, considering mosaics and ancient floors in general to be an essential part of an archaeological site, undertakes to make them known to a wider public and to ensure that, fragile as this heritage is, it can be passed onto future generations.

1. It recommends that professionals quantify the area and state of preservation of mosaics on each site (mosaics *in situ*, uncovered, re-covered, lifted, on display in museum, etc.) in order to establish priorities in treatment.
2. It acknowledges that mosaics of interest to the public should be preserved *in situ* whenever possible, which requires that directors of sites allocate them the requisite financial means and attention so as to ensure their maintenance and survival.
3. It acknowledges that conservation *in situ* (without lifting) is the method that best respects the original context of the mosaics, and recommends the use of techniques compatible with the nature of ancient materials.

Conclusions and Closing Remarks

Roberto Nardi

It is always very difficult to draw conclusions from a conference. It is extremely difficult to draw conclusions from a conference as successful, interesting and constructive as this one has been. There is very little to criticize. And at this time of day all of us are very tired, except Dimitri (Michaelides)! But the real point is that I am still very surprised at what I have seen during these past days. I remember previous meetings not long ago which were very different; we were a small group of restorers, each one of us very proud, secure in our own secret operations. We were the only people to be right, and we used to spend most of the time complaining amongst ourselves about the lack of attention that archaeologists and architects paid to our work. And then when we went out into the field, we always discovered that the situation was dramatically different. So, where have all the supermen or super-restorers of the previous meetings gone if the mosaics and cultural heritage are in the condition that we all know? I remember the long, heated discussions which we all had, expending thousands of words on really small details — beautiful pieces of theatre for the observers included in the price, but not constructive at all. The feeling was

more of a war between professionals than something built together. This sounds as though it was many years ago, but in reality only a very, very short time has passed since then. It is evident that things have changed, and these past few days, which we have spent together in Cyprus, have provided the first opportunity for this change to become readily apparent. We have seen that we can propose different solutions to different problems; we have heard professionals commenting on their own activities, without secrets, and also criticizing or admitting failures. And, especially notable, we have seen attention paid to the results. Our discussions have gone beyond the details in order to encompass significance and principles. The room has been full of our ex-enemies: the archaeologists and the architects who have participated in our work. I have been impressed not only by the level of the papers but also by the discussions. While papers can be prepared, questions and discussions cannot. The level of the questions has been really high and constructive. It is very evident that we have made great strides. What we have seen here has been not only the sharpening and refining of the tools to facilitate progress in familiar directions, but more importantly we have also heard phrases such as "informing the public", "presentation" and "interpretation of sites", "maintenance", "training", "landscaping", "preventive conservation". This means that all of us, as a group of professionals, are implementing the results already obtained, and we are laying the foundations for the future progress of our profession. All of this has been achieved in an incredibly pleasant and friendly atmosphere, for which we have to thank our Cypriot friends and Dimitri (Michaelides).

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